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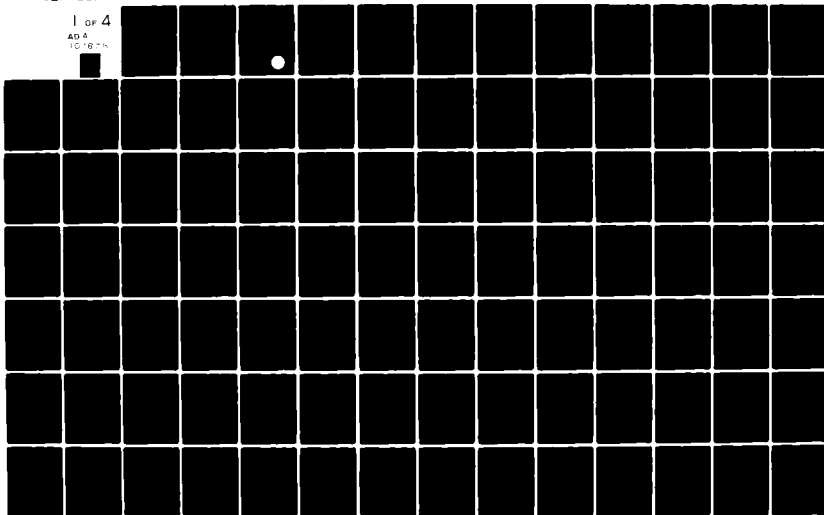
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A STUDY OF RESEARCH AND DEVELOPMENT CONTRACT
REQUIREMENTS AND THEIR GROWTH

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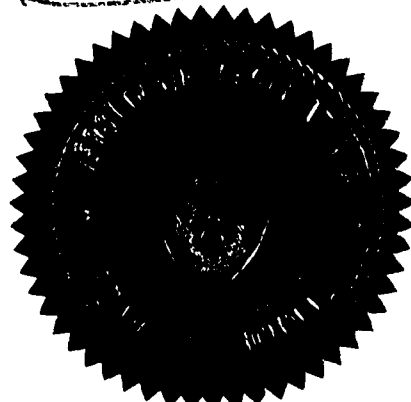
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A STUDY OF RESEARCH AND DEVELOPMENT CONTRACT
REQUIREMENTS AND THEIR GROWTH

by

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DISSERTATION

Presented to the Faculty of the Graduate School of
The University of Texas at Austin

in Partial Fulfillment
of the Requirements
for the Degree of

DOCTOR OF PHILOSOPHY

THE UNIVERSITY OF TEXAS AT AUSTIN

May 1979

DEDICATION

This dissertation is dedicated to my parents, Roscoe and Betty, whose loving and consistant pressure towards excellance was only recognized after leaving home, and to my wife, Lillian, whose restless search for fulfillment brought us both to an adult relationship with God.

A STUDY OF RESEARCH AND DEVELOPMENT CONTRACT
REQUIREMENTS AND THEIR GROWTH

Publication No.

Ronald Gene Blackledge, Ph.D.
The University of Texas at Austin, 1979

Supervising Professor: Eugene B. Konecci, Ph.D.

✓ Military contracts for the development and procurement of weapon systems and associated hardware components deal with definitional statements concerning those products called technical requirements. Conceptually, there are different types of technical requirements which range from broad goals stated in Mission Requirements, to subtle and small details reflected in Design Requirements.

This dissertation was a pilot study on technical requirements and was split into two parts. The first part investigated documents which commonly reflect requirements in Air Force developments. The document type chosen was the Part One Critical Item Specification. The intent of this part of the research was to see if proposed conceptual requirement types could be found in

✓
standard documents, and if so, whether the types fully exhausted the document's supply of requirements. Study results indicated that the proposed categories were appropriate but that the overlap between requirement types made isolation a gross rather than precise process. Recommendations for future study of this area included proposal for a small group investigation of requirement counting and classifying.

The second part of the study was to investigate the relationship between the requirement categories. A common belief in military development circles is [↑]that there is an orderly growth evidenced in requirement types through a project's development life cycle. All requirement types are known to grow with time. Depending on the requirement type, it is believed that some grow faster than others and that this growth is predictable. Data were analyzed and a growth model consistent with the results was proposed. Recommendations for future study included the specific areas to be emphasized in confirming this proposed growth pattern.

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CHAPTER ONE - HISTORICAL BACKGROUND

Introduction

Since man first shaped a stone into a wheel, he has pursued an increasingly complex process of sorting and analyzing his steps and their consequences. Ironically, perhaps, the process has received the most sophisticated attention in one of the areas that most affects man's short-run survival - - the development of weapons. This dissertation deals with complex weapons and associated equipment as they are developed by the United States Air Force in conjunction with American aerospace companies.

The specific focus is on requirements, a term much used in weapon system acquisition, but one which is quite ambiguously defined. A key objective is to more rigorously study the term "requirement" to identify a taxonomy of requirement types present in the weapon acquisition process. Each requirement type is evaluated for its potential to be isolated and counted using standard documents of the development process. Finally, relationships between the initial numbers of requirements in each category and those numbers at some common conceptual point later in the development cycle are investigated.

Definition of a Requirement

A requirement is "something wanted or needed" as defined by Webster. The weapons acquisition process has evolved more constraints on this basic definition. Although this modified definition is not legitimized by the Air Force in a formal glossary, it is commonly accepted in practise:

A requirement is a formally expressed goal whose outcome can be individually verified.

This simple definition carries some background elements with it generated by the unique environment. First, a requirement is understood to be a formal expression. This means it must be written or recorded so as to be available for verification of its various terms. It also means that it must be transmitted from one party to another in a commonly accepted format. A specification document is a common American convention for transmitting requirements. The outcome of a requirement must be independently verified upon completion. This can be in the form of a test, an analysis, or an inspection. Exhibit One gives a typical specification format.

AN/ARN-1000 SPECIFICATIONS

1. The AR/ARN-1000 Airborne Radio shall operate in the low frequency band and will provide accurate long range navigation for B-52, FB-111 and KC-135 aircraft.
2. The radio shall consist of the following components: receiver unit, processor unit, control and display equipment, antenna coupler unit, and equipment rack.
3. The receiver unit shall take signals from the antenna coupler unit and smooth. The resultant signal shall be sent to the processor unit.
 - 3.1 The receiver unit shall conform to MIL-SPEC XXXX provisions for reliability and shall include the following components.
 - 3.1.1 Component A consists of
 - 3.1.2 Component B consists of
 - 3.1.3 Component C consists of
 - 3.1.3.1 Component C/1 consists of
 - 3.1.3.2 Component C/2 consists of
 - 3.2 The processor unit shall consist of
4. Total system mean-time-to-repair shall not exceed 150 hours.

EXHIBIT ONE

CAPSULIZED EXAMPLE OF A SPECIFICATION DOCUMENT PAGE

Study Context

A weapon system moves from vague concept to concrete reality in halting and non-uniform steps. Even knowledge of the broadest weapon system needs is often imperfect and subject to change over time, because of perceived threat modification, technological breakthroughs, and changing priorities for scarce resources. This leads to an imperfect and shifting base of requirements upon which still more tenuous alternatives and trade-offs are made. The level where many operational needs begin to coalesce around one weapon system which will satisfy all these needs is the highest rung in a requirements ladder (See Exhibit Two). The amalgamation of needs derived from specific Air Force documents, such as Required Operational Capability or Specific Operational Need papers, are coordinated through Department of Defense, Office of Management and Budget, Executive Review, and Congressional committee review for approval. If successful, they become a Program Management Directive, which is levied from Headquarters, Air Force upon Air Force Systems Command. Air Force Systems Command assigns the embryonic requirements package to an intermediate development group (in the case of aircraft and associated equipment, it is the Aeronautical Systems Division). This group assigns the requirement

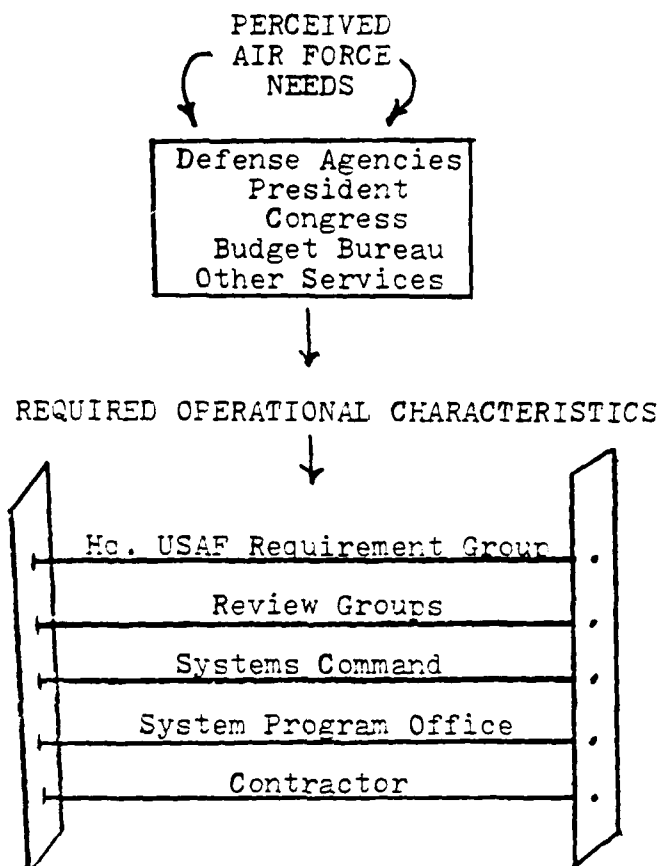


EXHIBIT TWO
THE REQUIREMENTS LADDER

package and direct developmental responsibility to a System Program Office which negotiates with an aerospace contractor for the actual engineering effort. The characteristic of uncertainty is present in virtually all development projects, regardless of its context. Peck and Shearer¹ view weapon system acquisition uncertainties as more intense and markedly different from those encountered in private business. The highest rung of weapon system requirement ladders experiences external uncertainties which include postulated scenarios of enemy intentions, estimated capabilities of competing weapons, and the risk that national priorities will divert necessary funds away regardless of program merit. Internal uncertainties enter on lower rungs. Since weapon systems usually push the technology frontier, the uncertainty is large. These internal uncertainties are primarily those associated with encountering those new technical difficulties and with the growing complexity of a large number of unknowns, which must interface. The process of solving these problems has become an iterative one:

The principle activities in the major system acquisition process are iterative. As more knowledge of needs, alternative solutions, actual capabilities, resources and priorities is acquired, some steps in the overall major system cycle may be iterated, as

necessary to permit decisions to be made in a total system context. It is difficult to graphically illustrate all of the possible iterations which might be involved.²

Uncontrolled iteration is the bane of an orderly weapon development process. Not surprisingly, this has pushed Air Force management to center their attention on control of the process. This process perspective, some knowledgeable critics say, has come at the expense of adequate attention to the objectives (requirements) which that process was supposed to secure:

Management has the function to solve problems that stand in the way of objectives. It is easy to become so preoccupied with how we are managing our management systems that we forget what we are managing and why - - our objectives.³

The Link to Public Administration

A systems management perspective and the resultant preoccupation with process to the detriment of goals, is not unique to the Air Force. This phenomenon has been observed in the larger set of American public administration. One noted writer (Kaufman, 1956)⁴ traces the growth of American public administration through three ages. The first age was dominated by American "Yankee Independence" which was gained, in part, as a reaction to harsh British rule. During this age of government, the individual rights of each per-

son were jealously guarded and the governmental institutions were established to be as representative of constituents as possible. Inherent in this system was the belief that popular goals could be achieved by wresting some consensus from diverse inputs. The very diversity of input allowed all important alternatives to be considered. The democratic process of logical debate, compromise, and majority rule was considered a sufficient mechanism for selecting one course from many.

As Kaufman explains, this noble experiment eventually developed a tragic flaw. The growing number of decisions required of government, coupled with their increasing complexity and difficulty, generated strong pressures to reduce the diverse inputs to a manageable sub-set. This license to limit inputs was not administered in a manner to either recognize obligations to diverse constituencies or to increase the probability of netting all important alternatives. Rather, it grew as an adjunct of power and the political process. Access to the governmental decision process was increasingly left to the bureaucratic specialists and their immediate circle of constituents. These specialists were increasingly appointed as a result of political

affiliation and favor, rather than special knowledge or sensitivities to popular needs. In short, the representative style of government eventually decayed into what has commonly become known as the "spoils system", present during the time of Andrew Jackson. The reaction to this spoils system was widespread and long-standing.

From the 1830's to the Pendleton Act of 1883, criticism grew but no vehicle of change emerged (Mosher, 1968)⁵. Even the Pendleton Act, inspired by the British civil service, was more important for the seeds of change it carried than for its revolutionary impact on the existing government. The new civil service system, wrought by the Pendleton Act, accepted the dual principles of standards for minimal job competence and political neutrality for its members. This age is described by Kaufman as the "neutral competency" age.

A hallmark of this politically neutral system was job protection or tenure for employees in virtually all cases except gross impropriety or widespread governmental reduction in job positions (not just people). Even these cases were handled by highly specific, standardized steps, and there was an easily accessible appeal channel for job holders thus threatened. Members of the growing American bureaucracy were thus

increasingly isolated from pressures not directly related to actions of gross impropriety. Further, the standard for judging one's job performance became efficiency - - the accomplishment of a given task with a minimum of resources and energy expended. As the standard of minimum performance became more codified for each job, the main question became how efficiently one met that standard. Both factors, the isolation inherent in political neutrality, and the growing emphasis on efficiency standards based on narrow job descriptions, caused an inward and rigid perspective on pre-set performance criteria. Responsiveness to change or questioning of job standards relative to program goals gradually became uncommon. In General Holzapple's modern day analogy, focus on the management system has taken precedence over concern for the objective.

Kaufman sees the growing pressures on presidents such as Kennedy, Johnson, and Nixon to cut through bureaucratic red tape as indicative of the third age - - that of "executive leadership". While this age brought a new conflict to the members of the burgeoning American bureaucracy from above, it did little to change their narrow and rigid perspective. This third age has meant confrontation but not obsolescence of the modus operandi established in the second age.

Having witnessed the growth of American public administration in much the same perspective as Kaufman, several public administration scholars stepped back from the problem and defined it in more general terms. Lloyd Nigro describes a characteristic of public administrators by borrowing a term from Karl Manheim called "functional rationality":

A series of actions organized in such a way that it leads to a previously defined goal. Every element in this series of actions receiving a functional position or role. Functional rationality is enhanced when means are coordinated most efficiently.⁶

In Nigro's terms, the neutral competency period and the subsequent executive leadership period had so constrained administrators' perspective inwardly and on process to the exclusion of goals that their actions could be essentially described as functionally rational. The ultimate harm was the de-emphasis on objective. Herbert Simon addresses more directly the process an administrator uses in decision making. He argues that any decision has in it inherent parts of fact and value:

Factual propositions are statements about the observable world and the way in which it operates. In principle, factual propositions may be tested to determine whether they are true or false Decisions, are something more than factual propositions.... they select one future state of affairs

in preference to another and direct behavior toward the chosen alternative. In short, they have an ethical as well as a factual content....Since decisions involve valuation of this kind, they too cannot be objectively described as correct or incorrect.⁷

This "value" (which is generally overlooked) is a measure of the association of the utility of any given decision to broader goals. Often, it is a testing of a decision against criteria defined by higher program goals. "Fact" is associated with the analysis of a situation. It is the latest analysis of "what is" in a dynamic process of change. Analysis and emphasis on the process of change is a good thing in that it leads one to seek logical relationships and to try and find patterns in a morass of events and activities. The quintessence of logical inquiry was considered to be functional rationalism. Using either Simon's or Nigro's perspective, we see how public administrators have evolved a systematic management approach preoccupied with logical sequences of activity and only loosely checked by comparison with broader program goals.

It has been argued that American public administration has evolved from a representative system sensitive to popular goals into a bureaucratic system preoccupied with management systems and efficiency standards. The inner workings of a public agency reflect

this general condition in specific ways. Emphasis on standards for performance in an agency as the test rather than political attributes of a job candidate, led to detailed job descriptions for each position. Since a person's job is minutely defined, performance is usually measured by how efficiently he does the prescribed job. No mention is made in the position description of license to ignore or modify tasks because they may no longer fit the program goal. Innovation is rarely rewarded if it comes at the clear expense of a written task, because rewarding even a good innovation thusly sets a precedence of condoning rule breaking. Not only does the internal standard of each job description foster this narrow perspective, but so does the relationship between job standards. As civil service organizations have developed, a hierarchy of job position descriptions has emerged. Each job description is formally related to those upper, lower, and lateral positions by lines of command and coordination. In a real sense, the role descriptions of each organization is thus functionally rationalized.

The Air Force as a Public Agency

The history of Air Force weapon system acquisition shows marked traits of political buffering and functional rationality. From its earliest days, the military has used civilians directly controlled by the civil service system for a major part of the standing force responsible for weapon acquisition. This is the same civil service system spawned by the Pendleton Act and just described as now containing highly structured job and organization functional descriptions. Positions not held by civilians have been held by military officers. This officer corps grew during the same time as the civil service system and shows some common characteristics. Although the concept of an elite officer corps is ancient, the constitutional requirements for civilian political appointees as leaders serves to blunt political inputs of such a tight-knit and stable organization. This protection of national decision making channels from military influence has had the reverse effect as well - - that of making the military hierarchy resistant to diverse political influences. Thus the military also has evolved an analogous system based on job descriptions and functional rationalism. While there are some major differences, such as military job

rotation based on individual career progression concerns and not job slot competition, the way civilians and military reach technical decisions are essentially the same.

Air Force Acquisition History

During the days of George Washington, a cannon was bought by specifying some minimal and very gross functional requirements (e.g., it must throw a sixteen pound ball two hundred yards) and reliance on the reputation of the builder. The weapon goals were specified in terms of the mission it was to serve. Inherent in this business transaction was the trust that both parties knew well enough what constituted a cannon. Further, accepted practices were sufficiently developed for producing that cannon so that no bad surprises (such as a barrel melting after ten shots) would develop. Weapons were simple; contracts were simple. In 1798, Eli Whitney successfully applied a relatively new concept of interchangeable parts on muskets and contracted with the government to manufacture them. Eli Whitney demonstrated that planned attention to detail and the use of engineering tolerances could produce a product which assembled on the first try. Weapon system design took its first serious step into design detail. No longer would requirements levied on contractors be as they

were in George Washington's time. Henceforth, considerations about product component design and engineering tolerances would be a commonly accepted facet of the contractual transaction.

Using this partial history, it is now possible to begin to weave the historic development of weapon system acquisition into the fabric of a public agency's functional rationalism. Requirements, now as then, are of two major types. First, there are required characteristics of the product itself. Highest of these are the requirements for the mission to be accomplished, followed by other functional statements necessary for the product to exhibit such traits as good maintainability and reliability. Next comes design details. These specify the composition of the product rather than its function. A second type of requirement is one specifying some type of contractual performance or compliance. This type centers on the contractor's process and not on his product. In essence, it grew as an amalgamation of "lessons learned" from prior developments and ultimately became formalized in regulations and manuals specifying various management schemes, techniques, and reporting systems.

Functional rationalism is said to have a definite impact on goals because of the preoccupation with

process. The Air Force weapon system acquisition analog to the general term "goal" is the more specific technical requirement - - the first type of requirement in the above description. The analog to the general term "process" lies in the government management and reporting systems. Those invoked on contracts are the second type of requirement.

Resuming with history, little change occurred in the military procured weapon systems during the years 1800 through 1917. The development process was generally left to the private contractors, or done completely by the military in various arsenals. Only sporadic interest was shown by various individuals of the Army Quartermaster Corps or the Signal Corps. The function of the government agents was basically one of procurement, and that of contractors was supplying a product they had already developed and made production ready.

In the fall of 1917, a Signal Corps Experimental Laboratory was established at McCook Field (now Wright-Patterson Air Force Base) near Dayton, Ohio. It was intended to form the nucleus of military research and development of experimental systems, which included airplanes. It grew and diversified during the next two decades. Whether actually conducted by the Army

or only monitored by them, research into the development of weapon systems was no longer the exclusive domain of private contractors. Even at this early time, the use of civil servants had become popular in order to maintain a stable pool of experts in functional areas. Functional organizations became an accepted principle during this time. For example, the engine experts at McCook Field were in one shop and supported development of several aircraft engine types from that home office. The traditional way of building an aircraft during that time was to use several diverse contractors, each supervised by a functional shop, and to somehow arrange a cooperative plan for all products (such as engines, instruments, and landing gear) to be sequentially delivered to the developing air-frame for assembly.

The functional shops found themselves supervising an ever more complicated situation as time went along. Referring to an earlier time, if one were building a musket using Eli Whitney's interchangeable parts, he might get the barrel from one contractor, the stock from another, and the trigger mechanism from still another. Interface between these parts could readily be controlled by reference to design detail drawings and special emphasis on engineering tolerances. It is im-

portant to note that such interfaces, even then, might be between different contractors as well as between parts. As long as accepted practices were dominant in the industry, and the interfaces low in number and complexity, assembly was accomplished with minimal problem. As airplanes became more complex, it became evident that the interface problem was no longer one of basically scheduling and assembling all procured parts. This growing problem, pushed along by power struggles among the functional shops, led officials at McCook Field to look for a better organization structure. In 1939, the first project shop was established.⁸ The project shop took functional experts and assigned them to specific development programs under the operational control of a single leader. Although the expert was often administratively retained in his functional home office, he was operationally controlled by the project leader. Equally as important, resolution of conflicts between functions, which often occurs at the interfaces, now had a formal home with the project leader, instead of the previous situation in which relative power of the functional offices prevailed.

The Army now had two principle weapon acquisition functions at McCook Field. First, they were involved in development of airplanes and their compon-

ents. Just as importantly, they supervised the assembly of the developed aircraft in production. No single government office controlled both efforts. Dual development and production offices for each program was the rule and it worked well for many years. In the mid-forties, the B-29 Bomber was developed. The system complexity had reached such a point by this time and design and detail was so great, that no clear break point between development and production was evident. In a real sense, the integration problems of the various complex aircraft systems were so numerous, diverse, and interrelated, that interfaces normally worked during the production phase were being anticipated earlier in the design phase. Modern weapon development had come of age. Component design was now accomplished with an eye towards future interfaces. Making this now complicated development/production process work required integration of the dual program offices into one - - the first integrated System Program Office.⁹

The period between World War Two and the early 1960's saw a constant battle between two agencies and between two concepts. The agencies were the budding Air Research and Development Command, which was established by the Ridenour Committee of the Air Force Scientific

Advisory Board, and the older Air Material Command, which had previously supervised the early integrated program offices. The old belief in separate programs for development and production had already died. The obvious question revolved around which side of the interface should control the whole process - - development or production. The process moved from the dual program office concept originally used, to a "team captaincy" concept of Air Force Regulation 20-10 in 1954. It went through the "Gillette procedures" involving direct reporting to the Air Staff in 1955, to, finally, the Weapon System Management Study Group of 1959 which relegated Air Material Command to a secondary role. The question was thus answered and the balance had shifted to the development side and to the Air Research and Development Command.¹⁰

The two concepts at odds were the polar extremes to a question concerning who controlled the technical experts. With the growing complexity of weapon systems, private contractors found themselves hiring an ever increasing number of specialized experts. Unlike the military, these contractors could not simply assign their excess talent to basic research when not needed on a contract, they either found another contract or fired the excess. This often meant firing excellent talent

simply because no current contract needed that particular talent at that time. Contractors diligently searched for a way to maintain a stable labor pool of experts and soon came to covet the basic research and supplementary technical support on various contracts given by the functional shops at McCook Field. The functional shops at McCook Field, however, were deeply entrenched in the bureaucracy by the late 1940's. In the face of increasingly complex tasks, these shops generated pressure for larger increases in people and the ability to offer inducements sufficient to hire people away from industry in critical areas. Neither side scored a clear victory in this battle but it led to limited use of two new arrangements still used today. The first idea was to try a shift of the daily engineering burden of controlling a development and production from the government program to one single integration or "prime" contractor. Previously, the Air Force (which was officially constituted from the Army Air Corps in 1947) had matured from dual control to one central point of control for its development programs but it still did the engineering integration work itself. Now a contractor was hired who was to have total system performance responsibility for the component building and integration of the weapon system. The government program office still existed and

exercised final authority, but its role shifted towards management by exception.

The second approach occurred in response to the perceived missile gap of the early 1950's and our desperation to build an intercontinental ballistic missile in the shortest time possible. The Strategic Missiles Evaluation Committee of 1954 recommended a technical support engineering contractor be hired to advise the government on development of a missile placed on contract with a prime contractor. Their rationale for modifying the new prime contractor arrangement was set forth:

After considerable discussion and negotiation, the committee rejected the use of a single prime contractor for the program on the grounds that no single industrial organization possessed the necessary range of skills and over-all capability required to perform the task.¹¹

This type of technical consulting company was considered to be more flexible than a prime contractor because its focus was on solving short-run technical problems and not on the over-all development of a particular weapon system. Thus, such a company could bid for small, but highly technical consulting roles on many programs and therefore not suffer when the development cycle of any particular program had run its course. As one can see, this is the private contractor equivalent of the govern-

ment functional shops. Proponents of this type of company argued that civil service tenure guarantees and low relative governmental salaries were already turning functional shops into mediocre talent pools filled with people who learned their functional speciality years before and felt no pressure to stay current. The private consulting company, on the other hand, would be more flexible because it could immediately recruit in specific areas, pay the premium salaries necessary to hire scarce talent, and motivate employees to stay current through its ability to fire them simply and quickly for poor performance. The first contractor of this type was Ramo-Wooldridge Corporation.

Use of a prime contractor had reduced direct government engineering to technical management by exception. Further, it used government funds to maintain the true technical expertise in a program in the hands of their contractual adversaries. This was not considered altogether satisfactory and the subsequent rise of technical consultant companies was hoped to be an effective balance. Over time, criticism of these consultants also grew due, in part, to the conviction that the supposedly captive technical advisors had allowed their professional considerations to override their commitments to serve government goals. Where a program

might be interested in an acceptable engineering change which was inexpensive, the technical consultant might press for a more technically elegant alternative despite its cost. A Ph.D. in nuclear engineering does not want to measure radioactivity on a watch dial. This parochialism, coupled with their virtually unassailable technical base, was allegedly used to overcome government control of a program. Using Herbert Simon's terms, their overpowering control of the facts was their license to judge values. Modern Air Force weapon acquisition still uses a mixture of all three approaches.

John F. Kennedy's election in 1960 brought Robert S. McNamara to the job of Secretary of Defense. During the subsequent years, there was a dramatic increase in the scope of the Department of Defense Research and Evaluation Office's involvement in the military management process. This period was marked with increasingly centralized control and the institution of rigorous management systems to control the acquisition process. The introduction of McNamara brought a quick restructuring of Air Force acquisition. Basic research, that not pointed at a particular product, was assigned to a newly created Office of Aerospace Research. Air Force development was assigned to the Air Force

Systems Command and the Air Material Command was re-chartered as the Air Force Logistics Command. An outgrowth of the 1959 Weapon System Management Group findings was the assignment of all responsibilities for acquisition (control of both development and production contracts) to the Air Force Systems Command. This was fleshed out in a new weapon system acquisition concept which was documented in a "375" series of regulations, manuals, and pamphlets. The 375 series was extensive in its coverage of the processes a System Program Office must go through in a development, and it detailed a growing list of collateral systems for configuration control, program control, and management reporting.

Further elaboration and modification of the management system occurred in 1971 with Department of Defense Directive 5000.1. A principle purpose of this directive was to correct the high degree of centralization in decision making started in the McNamara era. This directive specified de-centralization and outlined how that would work. It added information on management discipline, and developed its own regulations outlining program managers' functions during the various phases of a program life cycle.¹² The Air Force implemented 5000.1 in an "800 series" of regulations, manuals,

and pamphlets supplanting the earlier 375 series. Further codification of the weapon acquisition process into life cycle steps, the specific delegation of responsibilities and authority, and various management systems are all included in the 800 series. As the process has matured, the sequential action chain has become more and more functionally rationalized both in terms of organizational roles and in systematic steps required in a given program development. Contests of power between commands have been somewhat smoothed, authority of command levels clarified, and transition between program life cycle phases delineated. Further, as the process has become increasingly defined, systematic approaches to developmental problems have risen. Cost, being a major problem in development programs extended over time, has received its share of attention. The concept of "life-cycle cost" (which requires consideration of maintenance, spare part and other costs as well as production cost) has appeared. "Design-to-Cost" emphasis on designing towards some target production cost has become popular. In each area, the problem has been analyzed and integrated into the already established development system.

A Conclusion on Requirements

The focus on product technical requirements has not received the systematic attention as has that on process. Strayer and Lockwood say about this problem:

The existing process turns on the main valve (the requirement itself) but it does not yet address, in sufficient detail, what should be included in the content pipeline.¹³

It is the thesis of this dissertation that a broad and flexible term must be defined to link high order conceptual program goals to specific design detail. Under this umbrella term a taxonomy of terms is necessary and some broad ground rules must be established controlling the build-up of content in each category. This term will allow emphasis of the step by step relationship of objectives as they are defined in increasing detail. It will serve as a foil with which process oriented management systems are parried to the ultimate end of achieving a more balanced style of weapon system acquisition. The term used will be the requirement.

CHAPTER ONE ENDNOTES

1. See Peck and Shearer's The Weapons Acquisition Process: An Economic Analysis (Bibliography Number 39).
2. Reference Office of Federal Procurement Policy's report "Major Acquisitions - A Discussion of the Application of OMB Circular No. A - 109", page 5 (Bibliography number 51).
3. Excerpted from General Holzapple's address "Air Force System Command Report 375 - 1 Number 53", page 1 (Bibliography number 18).
4. See Herbert Kaufman's "Emerging Conflicts in the Doctrines of Public Administration" (Bibliography number 25).
5. See Frederick Mosher's Democracy and the Public Service (Bibliography number 35).
6. Reference Lloyd Nigro's article "Administrative Behavior and Self-Rationalized Man" on page 29 of Political Science Journal, Volume 5 (Bibliography number 38).
7. See Herbert Simon's book Administrative Behavior, page 46 (Bibliography number 47).
8. See Putnam's "The Evolution of Air Force System Acquisition Management", page 2 (Bibliography number 44).
9. Ibid, page 3.
10. Ibid, page 5.
11. Ibid, page 8.
12. Reference Charles Hoskins' "Analysis of Engineering Transfer of Acquisition Systems", page 5 (Bibliography number 19).
13. See Daniel Strayer and Lyle Lockwood's article "What Are We Buying Here?", page 2 (Bibliography number 52).

CHAPTER TWO - - ACADEMIC BACKGROUND

Academia and Technical Management

The purposes of academic study are generally aligned with the growth of knowledge while those of practical management are with controlling alternate futures based on past experiences. When one first studies an emerging practical problem area, the interests of academic knowledge often coincide with concerns of practical management. The pioneering work of authors like Gulick and Urwick served for many years as both an academic base for study and a practical guide for operation. In weapon system acquisition, the pioneering work of Peck and Shearer has had a similar effect in establishing uncertainty as a key area of interest both of academic and practical observers. There is no argument that the academic concepts of uncertainty and the practical consequences seen by managers need further study. A more global question concerning weapon system acquisition epistemology is raised.

A discussion of management epistemology was raised by Kozmetsky and Cunningham in a 1974 paper. Their paper was intended to "provide a framework to link in a unique body of science the knowledge acquired through both the academic management and the practical

management."¹ Key to this dissertation was their recognition that a "theory of the nature and grounds of knowledge with reference to its limits and validity"² (their definition of epistemology) depended on both academic and practical conceptual constructs. They recognized that each of these types of construct were already defined in different functional contexts and that many already had their own sub-epistemologies. Thus academic disciplines of business administration, education, engineering, law, and public affairs must relate in practical environments of government, business, and unions, to name a few. The diverse conceptual constructs and sub-epistemologies requires assimilation of pertinent parts of each into partial management epistemologies. In this context, the practical and academic concerns on uncertainty form only a small part of an assimilated epistemology, just as if one used only parts of the academic functional constructs with a limited range of practical experiences. While this dissertation does not chart the boundaries of a weapon system acquisition epistemology, it adds another important element which is the study of technical requirements.

Early Studies - - Uncertainty and Complexity

Peck and Shearer set the pattern for subsequent writers in their oblique analysis of requirements in their book, The Weapons Acquisition Process - - An Economic Analysis.³ Notably, the term "requirement" does not appear in the index. The end points of the weapon acquisition process probably seemed too clear for discussion. One starts with a single need statement; one is satisfied only when a product is delivered. Their attention, therefore, centers on the process of taking the product from one extreme to the other. The prevailing characteristic of the process is that a few broad requirements grow to many specific ones. This growth of requirements takes a product from uncertainty to certainty. The process of taking requirements from one extreme to another involves a series of decisions over contemplated actions:

....we define uncertainty as the relative unpredictability of the outcome of a contemplated action.⁴

Peck and Shearer maintain that uncertainty can exist in two basic forms. External uncertainty is the uncertainty of need or strength of support coming from outside the program. It reflects updated assessments of the threat, desirability relative to technical break-

throughs, and relative priorities with other programs for allocation of funds. Internal uncertainty is that which is caused by the facing of technical difficulties and complexities within the program. It is the iterations and blind alleys one sees when trying to fit numerous complicated requirements into one puzzle. Peck and Shearer state that this is a major contributor to technical difficulties and have labeled this type of internal uncertainty as complexity:

....yet if the major effort is engineering, it has become increasingly complex engineering. Indeed the most striking feature of current weapon system programs appears not so much to be the magnitude of the state of the art advances attempted as their tremendous complexity.⁵

Some requirements get specified simply as a consequence of the higher requirements they meet. For instance, significant portions of an airframe can be designed using standard design concepts, materials and fasteners if the environmental performance requirement has been previously met. Other requirements are not so simple. These are what Peck and Shearer would call "technical problems". In continuing the above quote, they say:

This complexity creates uncertainty in at least three different ways: in total number of technical problems involved, in the inter-relationship between

technical problems, and in the reliability requirements generated by the sheer number of individual components.⁶

Requirements have thus been seen for their characteristics of uncertainty and complexity, and have been singled out for particular attention when they - - individually or in groups - - cause technical problems. Peck and Shearer's perspective centering on contemplated action included necessary elements of the definition of a requirement because only a culminated contemplated action can be forceful in a contract and Peck and Shearer's analysis uses outcomes of contracts as evidence supporting their positions. Requirements are the expression of a culminated contemplated action.

Later Years - - An Oblique Interest Continued

The tendency of looking at requirements only when they cause technical problems or exhibit the results of uncertainty and complexity, has been carried forward by other researchers. In a more positive perspective, these authors have tried to anticipate areas where problems would likely occur and focus on a subset of those most crucial to program success. These crucial and problem prone areas are listed as "technical performance parameters" and are tracked from early in a development. One researcher couples this

with a "subjective probability approach" (Timson, 1968).⁷ This approach hinges on the premise that although subjectively done, measures of uncertainty can be taken over time. An argument is advanced that "progress is characterized as a reduction in uncertainty", thus progress can be measured on identified technical problems. A major assumption in advocating such an approach is that a project can be expressed in terms of its critical parameters and that a combination of routine attention on straightforward requirements and intensive attention on critical requirements will lead to a successful development. This process seemingly covers the universe of requirements, but Peck and Shearer's concerns over complexity, and especially "the inter-relationship between technical problems" argue that the problem is, perhaps, more than the sum of its individual parts. While one can argue that a formalized process of graduated attention on selected problems is one useful management tool, he cannot argue that this process is a definitive answer to the nature of requirements growth.

Control systems have always been popular as a research topic due, in part, to the fact that they result in immediately useful conclusions. Meiners reviewed Peck and Shearer's work with the intent of describing a

system to control changes that occur in the requirements process from concept to implementation.⁸ Inherent in his approach is the assumption that program changes are anomalies in the normal flow of requirements evolution. Peck and Shearer attributed such program changes to program uncertainty, contractor optimism in bidding, and a lack of a sense of urgency. This led to schedule slips, funding slips, and ultimately requirements changes. The conclusions of Peck and Shearer were the result of a large amount of data accumulated from previous Harvard Business School studies, and in particular, an economic analysis of nineteen programs by the authors and their research team. Meiners uses questionnaires from program leaders and contracting officers of twenty-five programs. While his sample is more extensive, the depth of analysis is not as deep. He concludes that the four main causes of program change, in order of importance, are:

- 1). changes in operational requirements imposed on the system,
- 2). incomplete early plans and technical definition,
- 3). changes in program funding, and
- 4). changes in the program to accommodate new state of the art development.

Reviewing Peck and Shearer's previous definition of an

internal and external condition of uncertainty, one sees fundamental support by Meiners over its role in affecting programs. Classically, Meiners' causes (1), (3), and (4) are external uncertainties while (2) is just as classic an example of internal uncertainty. Recasting Meiners' list of causes into terms involving requirements, one sees the major causes of program changes to be either an externally forced change to what a program had previously considered a firm requirement, or the lack of definition by a program as to what actually constituted its requirements in the program. A particular salient point concerning incomplete early technical definition, is that such internally derived requirements are usually the first type to require statement in different terms and documents than the imposed operational requirements. In most cases, operational requirements are specified by agencies external to the program and are an expression of high order conceptual needs. Initial technical definition is more pointed at specific functional characteristics of hardware and even includes some technical detail. Considering Meiners' conclusion in this light, one is led to question the problem as being more than the sum of the parts. In this case, the different languages used between imposed operational requirements and derived functional and detail requirements can actually exacerbate each of the individual relationships.

Several studies have dealt with the subject of uncertainty but did not deal with the effects of requirement growth. As was previously covered, requirements growth is ideally envisioned as an orderly process which is disrupted by forces including those labeled as external and internal uncertainty. The bulk of the uncertainty studies focus on one of the consequences of disorderly growth, namely unanticipated cost growth.

Sponsler, Gignoux, and Rubin⁹ attempted to find some parametric estimators of program costs for fighter aircraft. Using historical data from twenty-three completed fighter programs, they generated a regression equation using aircraft empty weight, wing thickness ratio, and avionic power as independent variables. Despite mixed results on two still-developing aircraft, the equation appears to do as well as any previous estimator. A review of their parameters reveals an interesting relationship. Empty weight is a direct indicator of size. It has long been used as a measure of both uncertainty and complexity. Avionic power represents a modern day addition. Where large scale electronic integration has prevailed, both weight and volume have often decreased while functional complexity has risen sharply. A small ratio of wing thickness to wing chord is an indicator of "increased technical

sophistication".¹⁰ All three terms are thus highly linked to technical uncertainty and complexity.

One can conclude from the writings, to date, that uncertainty and complexity cause problems in a program's development, and that this is likely seen in its requirement growth pattern. Further, the consequences of such disorderly growth is shown in areas of performance, schedule, and cost. A disquieting note to this conclusion is sounded by Henry.¹¹ His look at initial conditions of weapon systems as predictors of cost, used the early development budget to predict subsequent program cost. He intended this parameter to serve as a surrogate for technical uncertainty, believing that programs embarking on the most uncertain development paths would have the highest initial development budgets. The study results showed no significant relationship. Henry did, however, note:

It may be entirely possible that the definition of development investment is inadequate to the task of measuring technical uncertainty. Despite the fact that a majority of programs (40 of 48) met or surpassed the performance goals set for them, and that the "science" of predicting what is feasible may be more efficient than the "art" of estimating cost or schedule outcomes, one should be reluctant to surmise that developmental effort has less effect on project success than other program variables.¹²

Perhaps Henry's intuition that development cost reflects technical uncertainty can be sustained with the addition of a single word. It is highly possible that perceived technical uncertainty is met with higher initial developmental budgets and that the perceptions were wrong. The study is not persuasive enough to refute the wealth of other findings which support the relationship of uncertainty and developmental problems.

A more direct study of uncertainty and cost was the entropy model developed by Martin.¹³ The basic premise of this model was that a thermodynamic law actually modeled information growth:

The expression has been defined as a measure of disorder in a closed system. This definition has to be redefined. Entropy is a measure of the amount of information in a system; in particular, it encompasses the number of choices available to a decision maker. Entropy relates to the degree of randomness of the information, not to informational efficacy. As entropy increases, information increases, uncertainty increases, freedom of choice increases, but the informational efficacy decreases as related to the specific source. In accordance with the second law of thermodynamics, the tendency is for the entropy in a system to always increase.¹⁴

Adding to this basic definition, Martin concludes that uncertainty, being directly linked to entropy:

increases in direct proportion to the number of unknowns involved and the distance in the future of the contemplated events. Thus uncertainty is a direct function of time.¹⁵

This leads Martin to measure relative uncertainties among programs by charting the size of their relative decision trees: the more choices for alternatives, the more entropy and hence the more uncertainty. The Martin model is intended to explore the conceptual relationships of cost and uncertainty and it concludes:

The conclusion emerged that cost and risk analysis should be combined into cost uncertainty analysis, and each aggregate cost estimate should include a section which evaluates cost uncertainties.¹⁶

The Martin model was subsequently tested using a Delphi method to reconstruct the decision trees of the Short Range Attack Missile.¹⁷ The conclusion was that some statistical support was found for the theory. Since however, this single sample asked program people to recast an already completed program, there is some concern that their recollections might well be a form of self-fulfilling prophesy - - high cost areas, in retrospect, would be seen as results of uncertainty.

An attempt was made to expand the Glover iteration of the Martin model to the F-5E aircraft.¹⁸

This attempt provided a cost variance of over 900 percentum from actual results and caused the authors to question the Delphi method for testing entropy. Evaluation of the Martin model leads a person to con-

clude that it is not an especially good vehicle for evaluating requirement growth per se. Uncertainty is a phenomenon that manifests itself differently on cost, schedule, and performance. The contention that requirements grow from uncertainty to certainty is so logical as to be a truism. Martin postulates growing uncertainty. The conciliation lies in the different perspectives. While there is an increasing number of alternatives in a development, and while effort on each means increased engineering time and expense, these alternatives are worked to conclusion. So while cost increases, requirements are becoming firmer. As cost uncertainty increases, requirement uncertainty decreases. Use of the Martin model to investigate requirement growth, therefore would require first a better validation of the model (in light of its mixed results) and then a validation of the inverse relationship between cost and requirement growth uncertainty. While this can be a valuable exercise for future researchers, the current research base makes it a highly tenuous and indirect alternative.

Learning Analogy Used in Understanding Requirements

If analysis of the direct academic work on weapon system acquisition has proven an unsatisfactory framework for understanding requirements, one must ask about

the use of potential analogies from other academic fields. Martin used the field of thermodynamics effectively to model cost uncertainty. A potentially valid field for evaluating requirement growth is the area of learning theory. Indeed, the ultimate definition of a program, from initial concept to final product, is inherently a result of learning. The mainstream of learning theory contains a concept called "attainment":

Attainment refers to the process of finding predictive defining attributes that distinguish exemplars from non-exemplars of the class one seeks to discriminate.¹⁹

A principle objective of learning theory is to put order into observation. A fundamental tool is the concept. One observes several instances of an interesting phenomenon and sees that there is a uniquely common group of characteristics which differentiate that group from other close ones. This is the attainment process. The sub-set as defined by its common group of characteristics is labeled with a term - - that term being the conceptual equivalent for listing all the characteristics. A term or concept is thus attained and retained by one's recognizing a mutually exclusive arrangement of characteristics which alone define that concept. How

one attains and retains the concept in memory is open to some conjecture between two different schools of thought. The conflict first became heated in the late eighteen hundreds between the Wundtian Elemental and Gestalt factions. The Elemental school forwarded the proposition that concepts were learned independently of associations with other concepts. Thus through rote memory, one learned and retained the defining characteristics of a concept. The Gestalt school proposed that learning and memory depended on the relationship of the concept with concepts already retained. One school proposes concepts with clear conceptual boundaries and emphasizes detailed study of those boundaries to the exclusion of all else. The second school proposes that concept boundaries are not so clear. Concepts are, in fact, clustered in many patterns with other concepts, much as in the logic associated with venn diagrams. Thus, understanding and remembering a concept must occur in association with the other related concepts. While many scholars freely borrow from both schools, no single eclectic school has emerged:

At the centre of all of these is the basic Gestalt issue, by no means resolved by the middle of the 20th century, of empty hookups versus meaningful organization.²⁰

In weapon acquisition, diverse operational needs coalesce around one integrated but gross concept of a weapon system. It is important to recognize that a weapon system is conceived specifically as an answer to a combination of important needs and not as a modernizing innovation sans specific mission requirements. No aircraft is built simply because it is time for a new model as is done with cars in Detroit. Once these needs are set, a research and development process occurs to obtain definition of requirements which will satisfy higher needs. Requirements beget requirements. Although higher requirements, they do limit the alternative range. A requirement is a formally expressed concept. What the process therefore contains is a hierarchy of concepts, each constraining the lower ones. The process of finding lower alternatives is generally done with some form of satisficing.²¹ As Martin showed, alternatives increase greatly as a program progresses while generally the designers do not, thus satisficing is more or less forced on a program.

Requirement growth is not only a process of sorting alternatives in a hierarchial framework. Work of previous authors cited (Peck and Shearer, Meiners, Sponsler, to name a few) technical complexity as a major

factor in program development. Peck and Shearer's list of three types of uncertainty caused by complexity established interrelation between technical problems as one particular type. Complexity, in part, is seen to be a development problem and is seen as one of association of requirements causing technical problems. The problems associated with combining technical requirements is thus not simply a summation of the individual problems. They more accurately fit the description of a Gestalt:

When spatial, visual, auditory, or intellectual processes are such as to display properties other than could be derived from the parts of summation, they may be regarded as unities illustrating what we mean by Gestalten.²²

This perspective leads directly to the premise that understanding of the weapon acquisition process will require not only a clear definition of requirement types, but also an understanding of the relationships between requirement types.²³

CHAPTER TWO ENDNOTES

1. Reference Kozmetsky and Cunningham's unpublished paper "The Importance of Management Epistemology and Reasons for Including it in the Integrative Course", page 28 (Bibliography number 23).
2. Ibid, page 2.
3. Reference Peck and Shearer's book, The Weapon Acquisition Process: An Economic Analysis (Bibliography number 39).
4. Ibid, page 17.
5. Ibid, page 42.
6. Ibid, page 42.
7. Reference Timson's article "Decision Making Under Aggregate Uncertainty: The Engineering Decisions in a System Development Project" (Bibliography number 54).
8. Reference Arthur Meiners' thesis "Control of Major Changes to and Resultant Cost Growth in Weapon System Acquisition Contracts" (Bibliography number 34).
9. See Sponsler, Gignoux and Rubin's thesis "Parametric Cost Estimation of Fighter Aircraft" (Bibliography number 49).
10. Ibid, page 7.
11. See Douglas Henry's thesis "A Statistical Analysis of the Effectiveness of Program Initial Conditions as Predictors of Weapon System Acquisition Program Success" (Bibliography number 16).
12. Ibid, page 56.
13. See Dean Martin's dissertation "A Conceptual Cost Model for Uncertainty Parameters Affecting Negotiated, Sole-Source, Developmental Contracts" (Bibliography number 31).

14. Ibid, page 121.
15. Ibid, page 168.
16. Ibid, page 123.
17. See William Glover and John Lenz's thesis "A Cost Growth Model for Weapon System Development Programs" (Bibliography number 14.)
18. Reference Anthony Babriaz and Peter Giedras' thesis "A Model to Predict Final Cost Growth in a Weapon System Development Program" (Bibliography number 1.)
19. See Bruner, Goodnow and Austin's book A Study of Thinking, page 22 (Bibliography number 4).
20. This is taken from the Encyclopaedia Britannica, the 1967 edition, Volume 10, page 371.
21. See March and Simon's book Organizations (Bibliography number 30).
22. Reference Willis Ellis' book A Source Book of Gestalt Psychology (Bibliography number 11).
23. For a discussion of the basic research sources and methods used in this dissertation, refer to Appendix One.

CHAPTER THREE - - THE CONCEPTUAL MODEL

System Acquisition

Weapon acquisition history has been a process of evolution from a fragmented military buying system involving several organizations into a single development and buying group unified under one command. The term "System Program Office" was given this type of group and it had the following characteristics:

- 1). the responsibility for development and potential acquisition of an entire system which includes ground test equipment, training and technical manuals, simulators and all other equipment and plans needed to acquire and integrate the basic into the existing force structure, and
- 2). the major autonomy in describing and justifying its actions and on-going requirements for manpower and funding.

A similar organization also arose, known as the "project office". Generally, its main distinction was that this group worked with less than whole system (e.g., a radio for use in several aircraft). Most often, this project office was directly controlled by an intermediary agency which took the lead in management actions for all external dealings - - especially for requesting and justifying funds needed and already spent. Currently, there are two basic types of controlling agencies, both variants of the original System Program

Office. One type uses a System Program Office almost exclusively for the external interfaces, and emphasizes technical responsibility in the subordinate project office. The second type, often called the "basket" System Program Office, evolved as a natural consequence of the functional shop organization. In this type, large areas of relatively common developments are grouped under one composite System Program Office, which once again handles the external interfaces. Whether one selects a project office or a System Program Office to model depends on what requirement types are to be investigated.

A Requirements Taxonomy

Strayer and Lockwood proposed a taxonomy for weapon system acquisition. Included below are the elements of that taxonomy with their description of each:

Mission Requirements ultimately quantify the need for acquisition. Included in this category are the functional definitions, e.g., transportation of troops, cargo; destruction of targets; transmission of messages, etc.. Also included in this category are surrogates for functions commonly called performance parameters. Examples of these are: speed, range, altitude, capacity, effectiveness, accuracy, etc.. In total, the mission requirements define the purpose of the system. They spell out what the system is expected to accomplish. They deal with accomplishment in the mission performance mode, that is, in a brief, usually mission-defined time span. Thus they are almost measured instantaneously during the test and operating modes. Measurement, and therefore evaluation, can be both rapid and reasonably accurate.

Operating Characteristic Requirements quantify many of the efficiency indicators of the system. They include a much longer time consideration because they combine the functional components of life cycle cost - - reliability, maintainability, quantity and quality operators, expected useful life, logistics support, and component interchangeability standards. These requirements impact on the system design. However, they are not usually measurable at the same time that mission requirements are measured. The success of satisfying such life cycle considerations is measurable only over time, frequently a rather long time continuum.

Design Standards and Specifications deal with the transformation of mission requirements and operating characteristics into hardware. They describe specific knowledge of measurement inputs into the design process. Included in this category is the stated order of preference for specifications and standards - - components, materials and processes. The order of preference results from the belief that specifications and standards are the corporate body of knowledge. They are codified lessons learned. As such, they become inflexible guidelines or directives to the contractor. We impose them as design constraints in order to avoid new development costs, assure standardization, strive for competitive procurement of homogeneous products, and avoid costs of nonstandard components. All of these are worthy and desirable goals.

Management Systems Specifications and Standards either specify the nature of an organizational behavior pattern or require the disclosure of specific managerial information. This category is exemplified by such things as program management requirements, system engineering management plans, reliability program plans, configuration management plans, cost schedule control systems, and the like. The purpose of each category in this requirement is common: to elicit a desired level of contractor behavioral or managerial response.

Legal Obligations include both mandatory and bilateral requirements that are placed on the contractor and the government program office by basic contract law, federal law, or agency regulations.

Legal requirements are designed to accomplish various national and program management objectives. These have various political, economic, technical or social dimensions. Examples are many and include the Walsh-Healey Act, OSHA, environmental protection regulations, equal employment opportunity regulations, the cost accounting standards, and many more. In addition to the legal obligations mandated by law, bilateral requirements are frequently agreed on by the contracting parties and include type of contract, method of payment, restitution, warranties, correction of deficiencies, government-furnished property or services, forward pricing agreements, adjustment for abnormal price escalation, and the like.

Programming Requirements are allocations of total program costs and quantities into annual or other periodic partitions. These are usually described in terms of funding ceilings, time-phased budgets, and delivery schedules. In an unconstrained mode, these requirements are a statement of when the mission need must be satisfied. These requirements are initially defined by the using command and modified by planning staffs and development agencies. Further modification or adjustment of programming requirements are made throughout the federal budgetary process. The resolution of programming requirements and mission requirements has been the focus of annual debate at the national level.¹

Two additions to the Strayer/Lockwood taxonomy are made for the conceptual model. Included in the definition of the Operating Characteristic Requirement is:

Operating Characteristic Requirements also include the functional statements that relate components or systems to some specific task necessary for fulfilling the mission requirement. These requirements are not so broad as to be mission requirements, themselves, but neither are they as inflexible guidelines as defined by design standards and specifications. An example of this type of requirement is

the statement that a radio must have a back-up transmitting capability in case of specified types of failure.

A further addition to the taxonomy is the addition of a new type:

Interface Requirements are a special class of operating characteristic requirement which, by its nature, deserves special attention. These express a preconceived relationship between different mission requirements, operating characteristic requirements or some combination. Interface requirements characteristically work with only one side of an interface and is intended to constrain design on the other side to a selected set of characteristics. They often work with specified functions and characteristics on an evolving design which is required to match an existing design on the other side of an interface. As design proceeds to its lowest level of detail, it is normal to see an increasing number of requirements which relate one detail requirement to another. This type of statement is a logical consequence of evolving both sides of an interface together. The lack of preconception on one side rules this out as an interface requirement and makes it simply a design standard and specification requirement.

The conceptual model thus uses an expanded Strayer/Lockwood taxonomy. For ease of description, the element titles have been shortened:

- Mission Requirements
- Operational Characteristics
- Interface Requirements
- Design Requirements
- Management Systems
- Legal Obligations
- Programming Requirements

The focus is further narrowed, as one might have surmised from the introductory chapters, to technical requirements. Indeed, it is the premise of the historical evaluation that Management Systems, Legal Obligations, and Programming Requirements have received a disproportionate amount of attention while the requirements which directly define a system have been neglected. The first four requirement types in the taxonomy are technical requirements and are the elements of study. Confining requirement types to technical ones leads to selection of project shops instead of System Program Offices which deal with the entire taxonomy of requirements.

The Life Cycle Development

When considering the relationships of requirement types over time, one sees a close parallel in the interest on the life cycle of a program. The product life cycle of a weapon system is not described in terms of requirements, yet it also addresses development of a product from concept to final product. Understanding and use of the notion of life cycle therefore provides a valuable touchstone with which to relate requirement growth.

The original cycle from a military vantage was simply inspection and use. The item was inspected or tested to see if it met a set of (often unwritten) needs.

If it did, it was purchased and put into use. Entry of the government into the weapon development business added that phase before an item was tested and used. As weapon systems evolved, requirements became more complex, and government involvement in early design phases became more intense. A phase for defining the needs of the program was added to the beginning of the program. Seen from another perspective, the problem of weapon system development was rapidly being functionally rationalized. The currently defined life cycle is:

- 1). Conceptual Phase - - This phase is conducted at the discretion of the Service Components without specific approval of OSD. During this phase the technical, military and economic bases for an acquisition program are established through comprehensive system studies and experimental hardware development and evaluation. It includes the early conception of new systems and the program execution required to provide the technology necessary to make the concept technically feasible.
- 2). Validation Phase - - This is the phase in which the major program characteristics, through extensive analysis and hardware development, are validated and is often identified with Advanced development. It is preferred that reliance be placed on hardware development and evaluation rather than paper studies, since this provides a better definition of program characteristics, higher confidence that risks have been resolved or minimized and greater confidence in the ultimate outcome.
- 3). Full-Scale Development Phase - - During this phase, the defense system including all the items necessary for its support is designed, fabricated and tested. An essential activity of

the development phase is test and evaluation, both that conducted by the contractor and the Service components.

- 4). Productive Phase - - During this phase, the defense system is produced for operational use.
- 5). Deployment Phase - - During this phase the defense system is provided to and used by operational units. The Research, Development, Test and Evaluation (RDT&E) program structure used in the Department of Defense is predicated upon the methods of budgeting used to fund certain phases of the acquisition.²

Technical requirements of the various types described in the expanded Strayer/Lockwood taxonomy (hereafter simply called the taxonomy) flow through the development part of the life cycle which ends at the early part of the production phase. The conceptual phase contains mostly Mission Requirements and aggregate system Operational Characteristics while the other extreme of the development phase, the early production period, contains the greatest number of all types. The general observation that all requirement types grow in number through a technical development, but that they do so at different rates provides a starting framework to study relationships.

Perspective on Growth

It can be said that knowledge is derived by fitting of observations to a usable conceptual framework. The first half of the conceptual model is the testing of concept against observation for the proposed

elements of the taxonomy. This reduces to questioning whether readily accessible requirement documents reflect these requirement types or not. Once it is established that elements can be adequately discriminated, the relational aspects become important. The second half of the conceptual model uses a requirements growth framework. Within that framework, it is believed that some requirement types show independent and predictable trends beyond the most basic assumption of universal growth. Mission Requirements are thought to be virtually independent of time. Design Requirements are considered to start quite small in number and grow faster than any other category. Operational Characteristics and Interface Requirements should show growth patterns between these two extremes. Acceptance of this conceptual pattern for growth of the requirement types leads to a generalization in two parts:

- 1). existence of predictable patterns reflects that requirement growth conforms to order, and
- 2). the proposed patterns of growth are a specific form of that order.

This second half of the conceptual model is tested by first counting the number of requirements in each category at a common starting point in some document com-

mon to different programs. Subsequent counts of these requirements are made for each category in each program, thus giving a growth profile. With these data, the first evaluation is of the basic bi-variate relationships of each category with time. Subsequently, the multi-variate relationships among categories are investigated.

Results of the analysis are intended to lead to support of the proposed patterns of growth and thus of the general statement that all requirement growth conforms to order.

CHAPTER THREE ENDNOTES

1. Reference Daniel Strayer and Lyle Lockwood's article "What Are We Buying Here?", page 4 (Bibliography number 52).
2. See Harold Barker and Charles Creighton's thesis "Service/OSD Interface in the Initiation of Major Defense Systems Acquisition", page 44 (Bibliography number 2).

CHAPTER FOUR - DEFINING THE CASE AND PICKING THE RESEARCH SITE

The conceptual model, built on the historic and academic background studies which preceded it, has already formed a basic outline of research:

- 1). Air Force development programs are used,
- 2). technical requirements defined in the taxonomy are elements of the study,
- 3). project offices in the Air Force are the locus of the study, and
- 4). requirement type growth over a project life cycle is the studied relationship between elements with a specific growth pattern postulated.

A sharpening of focus is necessary in defining a case rooted in concept, yet observable in existing data. Choosing the proper target for a study is an exercise in "epistemic correlation". According to adaptation of a F. S. C. Northrop idea, the conceptual model is described in terms of "concepts by postulation" with the meaning of the conceptual relationship expressed in formal deductive theory terms. Case data are gathered in an operational model which is highly specific to the specific target. This model is therefore expressed in terms of "concepts by intuition" where "the complete meaning of which is given by something which can be im-

mediately apprehended".¹ A problem can arise if the specific operational model, while valid to the particular organization selected, is no longer reflective of the more general deductive theory. The process of insuring that a model based on "concepts by intuition" properly reflects a model based on "concepts by postulation" is described as epistemic correlation.

The following sections of this chapter justify and relate the selected study targets to the concepts they are supposed to mirror.

Placement of the Study in the Life Cycle

The previously discussed phases of a program life cycle bear closer scrutiny. The conceptual phase is subject to some variation from project to project. Normally however, the variation is in the length of time the phase consumes rather than the requirement type content. The validation phase begins with the few Mission Requirements and Operational Characteristics derived during the conceptual phase and ends with almost the final set of numbers in each requirement category. While these requirements are evaluated and changed during the full-scale development phase, the emphasis during this phase is on change, not growth.

Because of the time span between concept and pro-

duction, and because different Air Force groups in the hierarchy control requirements using different documents throughout the time span, it is virtually impossible to find one coherent, yet common, set of documents to cover the whole life cycle for many projects. If one had to constrain his search to documents in only one phase, the validation phase would appear to be most appropriate since the majority of program change occurs during it.

In project offices, a common document used during the validation phase is the Critical Item Specification. Exhibit One shows a general format for Critical Item Specifications as well as higher order specifications. Each hardware or software component which can be individually identified (beyond a certain very low level) has one of these specifications.

During the early and middle parts of the acquisition phase, the Critical Item Specification is written primarily in functional terms since it reflects not actual hardware or prototype but only a growing concept of what the item should be. This document is called the Part One Critical Item Specification. After a formally designated review in the concept development called a "critical design review", this document is re-drafted into a more detailed description document called a Part

Two Critical Item specification. In the case of the Part One specification, emphasis is on evolution of the concept; in Part Two specifications emphasis is on making the concept producible. The Part Two specification builds on the evolution already incurred by the Part One specification since its initial version reflects the evolved baseline of a string of Part One revisions. Use of the Part One is thus preferred over the Part Two when evaluating requirement growth since use of the latter only obscures the great progress already accomplished in the Part One.

Use of both specification parts would be the preferred research alternative but the extreme volume of requirements in a typical Part Two specification suggests that it not be counted unless really necessary for the research to be meaningful. The previous rationale concerning concept development and producibility attainment being the respective specification goals, argues that the most sensitive specification to growth in requirements is the Part One. This true because of the general Air Force policy which makes weapon systems requiring advanced manufacturing techniques and materials rare. If the hypothesis concerning orderly growth is not borne out by the more change sensitive Part One spec-

ification, then expansion to the Part Two is not likely to change the results. Accordingly, Part One specifications are used.

Selection of the Research Site

There are three Air Force locations with enough projects to allow an adequate base of evaluation: Space and Missile System Organization in El Segundo, California; Electrical Systems Division in Boston, Massachusetts; and Aeronautical Systems Division in Dayton, Ohio. While there are differences in the programs at the various sites, all face common problems of uncertainty and all use essentially standard management systems. Of the three sites, Aeronautical Systems Division was selected. The Major reason for selection was the large number of projects. A second reason was the ability to gain access to projects because of the researcher's acquaintance with several of the major program leaders and staff.

Selection of the Projects

Earlier, the distinction between programs and projects was made. Another general distinction even among projects, is size. Smaller projects can be documented with one single Critical Item Specification. These projects avoid the complication of having a hierarchy of specifications with extensive cross-referencing

between them. Requirement counting is especially difficult in such a case because one reference to another specification may actually reference a number of requirements. Small projects are therefore a prime target. Another selection criterion used is the avoidance of more than one specification authored by the same person. In a small sample, such as this is, personal bias can be significant. This, of course, should also be true for the contractor's side. While they usually do not write the original specification, they are generally most responsible for the change words. Any project evaluated for change over time, must have a document reflecting at least one revision. Since there are projects, mainly small ones, which stray from the classical documentation route, this becomes a concern and serves as yet another criterion for project selection. A project showing documents with several revisions is naturally preferred to one with less changes.

Major organizations in various functional areas exist in Aeronautical Systems Division. Each has an array of projects under it. Discussions with several senior staff members prompted the conclusion that a technical understanding of the work analyzed would be highly beneficial in evaluating possible specification anomalies. In many of the highly specialized areas of

technical development, the knowledge of what is atypical is derived principally from specific experience in that field. The area of avionics was accordingly picked to best fit the researchers background. The term "avionics" attests to the degree that technical complexity has grown. Although a common term in Air Force technical circles, it was not included in dictionaries as late as 1966, and its 1978 dictionary definition carries the old connotation of "avionic electronics". The total field of aviation electronics includes flight instrument electronics, special purpose weapon electronics, and a class of electronics associated with navigation, weapon delivery and aircraft active and passive defense systems. This last class of electronics is the currently accepted definition of avionics.

The combination of all these criteria, serves to limit the available pool of projects. The major limit on the number of projects, however, occurs on the data collection and analysis side of the question. Requirement counting is a lengthy and, at first, an iterative process. This necessitates a further limit on the number of projects to a number within the available pool. The number of seven projects was picked after the first iteration of requirement counting was completed.

The implications of using seven projects do not

concern the requirements for statistical significance, as one might originally suppose. As will be shown in a later passage, the number of data points taken for each requirement type allows the statistical laws to operate to give a valid significance level. Rather, the problem is basically one of data homogeneity. Requirement growth patterns are considered to be predictable over time, even though different agencies work on them, and consistent among projects, even though different leaders are involved. Because of this, the Mission Requirements (for instance) of seven projects can all be summed and treated as one sample. Use of a limited sample of projects does not test the underlying assumptions of homogeneity rigorously. A consistent, but unrecognized bias in selecting projects for research could conceivably eliminate those projects evidencing leadership or agency influence. Thus a general and broad claim concerning requirement growth would be supported by a narrow and non-typical sample. This would be a classical case of improper epistemic correlation.

Project Versus Case Selection

Once one determines the number of projects to be evaluated, he can go two ways in using the data. Data collection procedures must be tailored to the type of

analysis anticipated so the analysis method must be considered as an early part of defining the case. One way to analyze the data is to use each project as a case unto itself. Possibly, there exists interesting differences between the projects even if all seven combined lead to some common conclusions. The study would then include the differential contributions of each project to the common conclusion, but dwell on the reasons for those differences.

This research starts with a different premise. Its first objective is to discover if there are any common conclusions, regardless of the differential inputs. The potential for one project to unduly bias the small sample is not ignored, but study dwells only on the existence or absence of influence rather than on root causes of the differences. Accordingly, the investigation of undue project influence on the sample is handled by the discriminating methods of residual analysis and plotting of outliers.

Using this relaxed objective of only searching for common conclusions has a statistical advantage. The sample size can now be based on the aggregate of projects, rather than individual ones. One can thus assume that every observation of any particular requirement

type is tied to any other observation of that type by time and not by project. As an example: if one were to observe Mission Requirements at time zero on a project by project basis, he would have seven cases, each with one observation. If he were to observe all samples at time zero (which incidentally come from seven projects) he would have one case with seven observations. The sample size is thus expanded by this expedient. It should be noted that this treatment of data does not require one to accept the premise that there are no differences between projects; rather, the chosen premise is that, despite potential differences, there are prevailing tendencies common to all projects.

To this point, the discussion has centered on the statistical advantages of combining data into an enlarged base not possible when evaluating on a project basis. These advantages come only by leaning heavily on the assumption of data homogeneity. This is necessary because even if the results derived from the supposed homogenous data does show marked common tendencies, it does not confirm homogeneity for the general theory involving all requirements, unless the sample of projects is reflective of the whole population.

The three major confounding influences to data homogeneity are involvement by different agencies in the

evolution of requirements, differences of product use (such as satellite versus aircraft), and differences of diverse project managements in the controlling of requirement growth.

Although different agencies are involved in a development, their direct control is virtually all in the conceptual phase and their product is mostly a list of Mission Requirements. The major difference among projects initially controlled by different agencies is reflected in the different numbers of initial requirements and not in the subsequent growth process.

Both Air Force history and academic analysis confirm that project management is basically differentiated by uncertainty and complexity from other management efforts, and that within this category, many common problems and solutions occur for a wide spectrum of products and company managements. Within the Air Force, this commonality has been further reduced to a code in manuals, regulations, and other restrictions and guides generally applied across all projects. In order to believe that differences are more prevalent in Air Force projects than similarities, one must believe that Air Force project leaders and workers grounded in common backgrounds, facing common environments of uncertainty and

complexity, and complying with essentially common management and reporting requirements still wield overwhelmingly diverse impacts on the requirement growth process. A necessary premise for maintaining homogeneity is that Air Force projects have common tendencies, not that they are identical relative to requirement growth. Logic and observation support this premise.

Orderly Growth

The concept of orderly growth must be stated more directly in order to be tested. Orderly growth is evidenced by linear relationships between independent variables and time, and by linear relationships between combinations of variables using one of their group as the dependent variable. Transformations are available, if necessary, to accommodate curvilinear data.

CHAPTER FOUR ENDNOTE

1. See Hubert and Ann Blalock's book Methodology in Social Research, page 10 (Bibliography number 3).

CHAPTER FIVE - RESEARCH ORGANIZATION AND ANALYSIS

Data are produced by processing raw information. Part one Critical Item Specifications, which contain written requirements, and numbers of requirements, by type, are generated. This process is done on each revision of each specification, and the time from initial specification publication is tagged to each observation. All observations of an initial specification are tagged with a time zero.

Use of Produciible Data

The selection of a part one Critical Item Specification is relatively simple, since few other documents are consistantly available among projects. Not only is the document available, but its use carries a requirement for a formalized system of control, including change control and filing. The other alternative to Critical Item Specifications is a document called the Statement-of-Work. This states what work is required of the contractor in a highly structured format which follows closely the hardware component breakdown. It is therefore a point by point statement of the work necessary to meet the technical requirements. It is an indirect measure of requirements as opposed to a Critical

Item Specification's direct measure. Further, the Statement-of-Work is written in general terms so as to not need changing as technical details are added to a product baseline. It is a poor indicator of growth.

Counting Versus Sampling

The decision between counting or sampling requirements from the specifications is essentially one of extending the usefulness of this dissertation beyond the immediate conclusions. If a sampling system can be devised and shown to accurately reflect actual requirement counting, then other researchers need only sample when investigating relationships. Whether counting or sampling becomes the recommended procedure, it should be recognized that counting is a necessary present feature. The sampling system can only be justified on the basis of its parallel results to counting.

Data Collecting Procedures

Data are collected from the specifications using a process described in Appendix Two. In keeping with an earlier charge to maintain an epistemic correlation as a bridge between concepts and observed data, the conceptual definitions of requirement types are modified to reflect their typical appearance in Critical Item Speci-

fications. These are not changes which delete any element of the conceptual definition, but rather are additions which make the conceptual definitions more precisely tailored to the document:

Mission Requirements in Critical Item Specifications are often included in the introductory paragraphs. Unlike the top specification of an entire weapon system, Critical Item Specifications generally describe a product designed to be used with something else. Further, the product is often a replacement for a previous obsolete unit. Relational statements concerning other interfacing units are thus common and Mission Requirement statements of Critical Item Specifications are usually not as complete and adequate as those for an entire weapon system. Relational statements must, in this unique instance, be counted as Mission Requirements.

Operational Characteristics in Critical Item Specifications initially describe the functions of each component in brief passages. Subsequently the major operational relationships between components are described.

Design Requirements in Critical Item Specifications are often specific and inflexible requirements about the most critical performance features. They are often intended to put a floor on performance at the level of current comparable units to insure getting a product which will give comparable or better overall performance. Since one detailed Design Requirement often directly constrains interfacing components, it is not unusual to see clusters of Design Requirements around a particular required performance capability.

Interface Requirements in Critical Item Specifications are usually first seen as a functional interface diagram. Interface Requirements in the rest of the specification seem to exhibit no pattern of early or late inclusion.

Two-Fold Nature of the Study

The conceptual model has two parts. The first part, comprising the elements of the study, is the investigation of the taxonomy to see if the conceptual elements can be identified and counted in specifications. The second part is the relationship assumed between these elements, that of orderly growth. Research of the data taken from specification requirement counting parallels the conceptual model with an analysis of the requirement counting process coming first, followed by linear regression analysis of element relationships. The basic organization of the requirement counting process is given in Appendix Two.

The Regressions

The regression analyses use The University of Texas at Austin's computerized version of "The Statistical Package for the Social Sciences, second edition."¹ The specific relationships investigated are:

- 1). Mission Requirements with time;
- 2). Operational Characteristics with time;
- 3). Interface Requirements with time;
- 4). Design Requirements with time;

- 5). Mission Requirements with Operational Characteristics, Interface Requirements, and Design Requirements;
- 6). Operational Characteristics with Mission, Interface, and Design Requirements;
- 7). Interface Requirements with Mission Requirements, Operational Characteristics and Design Requirements; and
- 8). Design Requirements with Mission Requirements, Operational Characteristics and Interface Requirements.

Positive relationships of each requirement type with time are the simplest expression of orderly growth and therefore are important. Mission Requirements should show virtually no growth at all, with Operational Characteristics through Design Requirements showing increasingly steep slopes.

The multivariate relationship can provide the accuracy of prediction not available in simpler bivariate equations. Analysis of the multiple relationships, especially the residual analyses and the variance/covariance matrices can give major insights to the patterns of growth and especially the effects of multicollinearity.

The projects which provide the data are listed in Appendix Four. The raw data input to the linear regressions are shown in Table One. Organization of that

TABLE ONE
REQUIREMENT TYPES - RAW COUNT OF 23

TIME	MISREQ	OPCHAR	DERSS	INTERFACE
0	11	61	143	18
0	8	69	364	26
0	9	117	531	120
0	3	16	275	62
0	11	63	286	39
0	6	229	149	62
0	8	121	94	43
4	8	127	101	45
5	8	150	133	56
5	11	65	302	40
7	6	341	340	81
13	7	360	632	104
14	9	85	603	37
15	11	86	252	32
15	9	120	585	123
16	11	71	336	47
17	8	176	149	68
21	3	19	292	79
22	8	238	192	89
29	11	75	422	47
32	4	31	335	93
34	11	76	438	48
51	4	44	427	120

NOTE: The following acronyms are used throughout the tables in this dissertation:

MISREQ - - MISSION REQUIREMENTS

OPCHAR - - OPERATIONAL CHARACTERISTICS

DERSS - - DESIGN REQUIREMENTS

INTERFACE - - INTERFACE REQUIREMENTS

data is chronological by months. All data relationships are presented without missing data. Thus correlation of any two requirement types such as Mission Requirements and time is made using pairs corresponding to the number of data "points" or observations. Twenty-three data points in the computer run translate to twenty-three pairs of Mission Requirement and time. The results of running the raw data in the linear regressions is shown in Appendix Five. Table Two gives some of the selected results. When evaluating the results shown in Table Two, the single most striking observation is the smallness of the bivariate correlations of each requirement type with time. When the projects were plotted individually, the requirement types exhibited a stronger correlation with time than the aggregate data indicated.

Transformation

After reflection, it seemed that when each project's contribution was compared with other projects, the very large differences in the initial numbers of requirements in each category swamped the regression and obscured the trend. In two requirement types, the differences in total initial numbers approached one order of magnitude. It is probable that if each project had started with a common base number at time zero,

TABLE TWO

SELECTED COMPUTER RESULTS - 23 RAW DATA POINTS

BIVARIATE CORRELATION COEFFICIENTS

OPCHAR	-.02328			
DERSS	.06743	.00954		
INTERFACE	-.49910	.30396	.44441	
TIME	-.18808	-.17663	.33421	.39799
	MISREQ	OPCHAR	DERSS	INTERFACE

MULTIVARIATE RELATIONSHIP OF MISSION REQUIREMENTS

$$\text{MISREQ} = -.6274 \text{ INTERFACE} + .6401 \text{ DERSS} + .6074 \text{ OPCHAR}$$

$$+ 9.3317$$

$$F \text{ SCORE} = .023$$

$$R \text{ SQUARE} = .3873$$

the resulting growth would have been closer to the intuitive results seen in the project plot. A transformation was done on the data. Each observation in every requirement type category was divided by the initial requirement number in that category thus making the transformed data a rate of growth figure on the base one. It was recognized that this made the measurement a ratio which carries its own special burden in statistical analysis, but it was felt that these potential problems could be dealt with effectively. Table Three shows this transformed data. The resultant computer run is given in Appendix Six. Selected results from that run are shown in Table Four.

Sample Size

Previous considerations of sample size concerned the goals of the research and led to an increased size from the original base because of the understanding that aggregate conclusions rather than differences between projects were desired. The first two data runs occasioned a second opportunity to consider the way data are fitted. When the common denominator for data observation shifted from the project to time no consideration was given to whether the original data collection methods were still appropriate. Had the research

TABLE THREE
TRANSFORMED DATA - - COUNT OF 23

TIME	MISREQ	OPCHAR	DERSS	INTERFACE
0	1.00	1.00	1.00	1.00
0	1.00	1.00	1.00	1.00
0	1.00	1.00	1.00	1.00
0	1.00	1.00	1.00	1.00
0	1.00	1.00	1.00	1.00
0	1.00	1.00	1.00	1.00
0	1.00	1.00	1.00	1.00
4	1.00	1.05	1.07	1.05
5	1.00	1.24	1.32	1.32
5	1.00	1.03	1.06	1.03
7	1.00	1.50	2.28	1.31
13	1.17	1.57	4.24	1.68
14	1.11	1.23	1.66	1.42
15	1.00	1.41	1.76	1.78
15	1.00	1.03	1.10	1.03
16	1.00	1.13	1.17	1.05
17	1.00	1.45	1.48	1.58
21	1.00	1.19	1.06	1.27
22	1.00	1.72	1.90	2.07
29	1.00	1.19	1.48	1.26
32	1.33	1.92	1.22	1.50
34	1.00	1.21	1.53	1.23
51	1.33	2.75	1.55	1.93

TABLE FOUR
 SELECTED COMPUTER RESULTS - 23 TRANSFORMED DATA POINTS
 BIVARIATE CORRELATION COEFFICIENTS

OPCHAR	.78996			
DERSS	.33339	.36964		
INTERFACE	.50680	.85118	.58529	
TIME	.62734	.79290	.24143	.65379
	MISREQ	OPCHAR	DERSS	INTERFACE

MULTIVARIATE RELATIONSHIP OF MISSION REQUIREMENTS

$$\text{MISREQ} = .3436 \text{ OPCHAR} - .2839 \text{ INTERFACE} + .50081 \text{ DERSS} + 89.371$$

$$\text{F SCORE} = 0$$

$$\text{R SQUARE} = .79329$$

been done originally on a time basis, it would have required that for every pre-set point in time, data be taken across the spectrum of requirement types for each project. Thus, if project A was the only project to change at time X, all other projects would still have to be counted at time X, even though unchanged. This led to an array of data as seen in Table Five. The resultant computer run is shown in Appendix Seven. As in the previous case, selected results are incorporated in this section in Table Six.

Evolution of the Final Model

When the transformed and expanded data base is analyzed, the results are markedly different from the raw data runs originally tried. While simple bivariate relationships with time are still not high, they have now increased to better than .5 in three out of four cases. The significances of all relationships is quite high, indicating a good fit of the data to the resultant equations. R square for the multivariate relationships are better than .8 for all except Design Requirements which is .61. The residuals of Y estimated values versus Y observed values for the multivariate equation describing Mission Requirements show five outliers which involve 7.81 percentum of the total number of points sampled.

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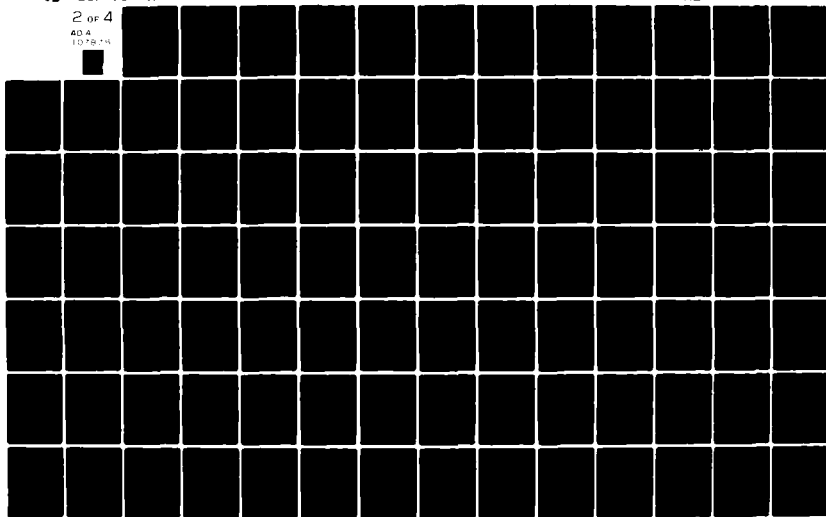


TABLE SIX

SELECTED COMPUTER RESULTS - 64 TRANSFORMED DATA POINTS

BIVARIATE CORRELATION COEFFICIENTS

OPCHAR	.79928			
DERSS	.40676	.45452		
INTERFACE	.54741	.87447	.64128	
TIME	.52805	.66998	.16147	.52342
	MISREQ	OPCHAR	DERSS	INTERFACE

MULTIVARIATE RELATIONSHIP OF MISSION REQUIREMENTS

$$\text{MISREQ} = .3811 \text{ OPCHAR} - .3056 \text{ INTERFACE} + .4824 \text{ DERSS} \\ + .87421$$

$$F \text{ SCORE} = 0$$

$$R \text{ SQUARE} = .81078$$

Three of these outliers are from the same program. On a subsequent trip to Wright-Patterson Air Force Base, this project was again examined. A change in the basic mission of this critical item had occurred subsequent to the first submission of the Part One specification. This fact had been known early in the research but a decision was made to leave it in. The change had been directed early in the project and, given the fact that the project was a long one, it was thought that the several specification revisions would allow a graceful accommodation of the various requirement types to the new direction, but this did not happen. Accordingly, data from this particular case were dropped from further consideration. The sample size dropped from sixty-four to sixty.

A computer program was now run with the sixty remaining data observations, but with raw data (see Appendix Eight). This was done to check the model sensitivity to the extreme data. The original rationale for transformation did not consider the possibility of isolated erroneous data acting as a strong force because of the small number of projects involved. Its conclusion, in fact, was that patently valid data, beginning from greatly different initial bases, had the common trends obscured. If removal of one anomolous set

of observations significantly changed the raw data correlations, even if the results were not as good as the transformed data, then a major blow would have been struck to the rationale for transformation. The results of the second raw data run were similar to the first raw data run with very low correlations with time and generally poorer statistical significances than transformed data as shown by the F scores. When the transformed data were run with the extreme data removed, only two outliers were found. This program was used for the major findings. The program is located in Appendix Nine and is discussed in the chapter on research findings.

The statistical techniques used in the multivariate analyses is principally analysis of variance using the computer's ANOVA routine. The ANOVA routine is basically an analysis of variance technique adapted for computers. It is based on partitioning of the variations of sums of squares of data conforming to factorial design. Linear regressions are investigated using this technique by noting the sum of squares of the residuals to that of the total regression. These values, adjusted for each figure's calculated degrees of freedom, are compared in an "F" ratio. The significance figure derived from tabulated F ratios gives the probability that a

null hypothesis exists that there is no linear relationship of the tested data. This technique is used for regression equations and for individual coefficients in the equations. Immediately below the F ratio analyses of a given relationship (as shown in the ANOVA computer print-out), the prediction equation is derived for the dependent variable. This, coupled with an earlier print-out of R square and standard deviation of the regression line defines the relationship. Several major options, including plotting of residuals, analysis of those data using Von Neumann and Durbin-Watson tests, correlation coefficient tables, and variance/covariance matrices are also offered by the ANOVA routine.

Step-wise inclusion of the independent variables into the model is used because this is the most general test and it allows insight into the dominant independent requirement type in predicting a dependent requirement type variable. This decision is even more appropriate when combined with the second decision to not specify a tolerance level for inclusion of independent variables into the model. All variables are ultimately input to the model.

Multicollinearity Investigations

It is reasonable to hold a starting assumption that certain requirements, such as Mission Requirements,

might directly influence the numbers of other requirement types. The bulk of the earliest requirements (seen in the early conceptual stage) are Mission Requirements. Further, the accepted practice of establishing precedence among specifications and among paragraphs in specifications, has been observed to attach importance to Mission Requirements out of proportion to their number. Taking two observations made about Mission Requirements to a level of abstraction, one could say that requirements that are established first in a chronological sequence and which are also deemed most important in case of requirement conflict, are most likely to force growth in requirements which come and are less important. Mission Requirements fit the "early" and "important" criteria and thus might force requirement growth in other requirement types. It can be seen that any argument that involves time, importance and requirement type, as they relate to requirement growth, is tenuous because it implies a cause and effect relationship based solely on a closed system of requirement types. This was a major consideration in not specifying a method other than step-wise inclusion for insertion of independent variables into regressions. The potential relationships cannot be ignored when investigating multicollinearity, however. Both the bivariate statistics and the variance/

covariance matrices give insight to this problem. Under the closed system, Mission Requirement causal theory, one should see the strongest multicollinearity relationships cascade down from Mission Requirements to Operational Characteristics to Interface Requirements to Design Requirements. A healthy multicollinearity between them all should therefore be found. A result showing orderly growth of the requirement types without multicollinearity does not hurt the orderly growth argument but it destroys the posited closed system. A complicating relationship to this analysis is that of Interface Requirements to Operational Characteristics. Strayer and Lockwood did not see enough difference in these two categories to separate them in their original taxonomy. If they are right, multicollinearity between these two categories should be extremely high. Multicollinearity plays such a big role in the conclusions of this research, that further discussion is held for the chapter findings.

Autocorrelation Investigations

Time series classically contain some or all of four types of movement. One author defines these as secular trend, periodic variation, cyclical movement, and irregular fluctuations.² The key to how one views

a time series is directly tied to his primary interest. In business, the secular trend is very often a simple reflection of population growth. Beyond this are the periodic variations such as seasonal influences. Often, when one controls for these two influences, he can see, for a given industry, that it runs in cycles. A businessman may wish to know where he is in a cycle or he might want to know what to expect from the Christmas rush. Depending on what he wants to know, he will control or suppress certain effect.

This analysis starts with a different focus. The aim is not to control the regression for some known trend in order to isolate independent effects, but rather to determine if the data indicates some secular, but unknown trend at work. The original belief concerning what caused order to be established in a system, was that certain forces like uncertainty, size, cost, and complexity set an initial burden on a development. The system responded in an orderly manner with Mission Requirements leading the process. If these external forces do not just set the initial conditions, but continue to act throughout the development, they will be seen as secular trends and will probably emerge in tests for autocorrelation.

Autocorrelation is checked using the Durbin-Watson Test and the more sensitive Von Neumann Ratio. Further, the effects of entering time as an independent variable is indicative and is investigated (see Appendix Ten). The results do not support findings of any significant autocorrelation in the data. The Durbin-Watson Tests and Von Neumann Ratios are generally negative with the only exceptions showing mixed results between the two tests in two cases. The inclusion of time as an independent variable improves correlations only at the fourth decimal, leading to the conclusion that any time based trend is not significant. These findings are not surprising, when considering the classical way a program is defined relative to these potential secular forces. While the state of the art of technical development increases with time, the effect on a program is minimized by tight control. Virtually all programs are required to assess their technical risk early in the development, and those with high risk are usually redefined. Development programs which push the state of the art are universally discouraged. A program starts with a certain (although sometimes unknown) degree of uncertainty, complexity and size. It generally proceeds to certainty. Changes involving obvious increases in complexity are

discouraged. Increases in size of the product, or the program are discouraged, although they do happen. It is logical to assume that control over these forces is better on the smaller and simpler projects and that is what the data support.

CHAPTER FIVE ENDNOTES

1. See Nie, Hull, Jenkins, Steinbrenner, and Bent's book Statistical Package for the Social Sciences (Bibliography number 37).
2. Reference Croxton, Cowden and Klein's book Applied General Statistics, page 214 (Bibliography number 7).

CHAPTER SIX - - RESEARCH FINDINGS

Ability to Isolate Requirements in the Taxonomy

The proposed taxonomy is used, not to be normative, but rather because it reflects the natural order of things relative to requirement definition. To this extent, one would expect to see an extensive number of easily recognized classical types for each taxonomy category. This observation was borne out by the study. Even among individual members of one type of document, however, (part one Critical Item Specifications for avionic units) it is apparent that there is an almost endless number of ways to compile requirements which defy their isolation to some conceptually pre-conceived taxonomy. The fact that there is no current Air Force requirement definition system testifies to the license available to specification writers to define requirements any way they wish. The principle normative influence on specification writers has been past experience and especially that in their own functional areas. These specifications are normally organized first by a component breakdown of the critical item and then by a fairly standardized set of additional considerations.

The guiding influence seen in current writing of requirements appears to be (beyond clear statement of the

idea at hand) good transition and integration with the requirements of other paragraphs. The general mechanical characteristics of a piece of hardware appears to have a bearing as well. A piece of hardware can characteristically be broken down into clusters of functionally oriented components which break down into smaller and smaller units. At the functional cluster level there are cross-functional interfaces. Within the clusters there are intrafaces between units and interfaces with units of other clusters. Thus a very simplistic view of a technical description would show that there are functional cross-sections at every level of hardware component breakdown. It is therefore not surprising that there are numerous requirement statements which do not fit the taxonomy cleanly. The distinction, however, does not seem to be that there are better theoretical categories possible, but rather that there is such overlap between the postulated types.

If one assumes that there are significant populations of requirement statements clustering around each conceptual requirement type, and that all other requirement statements are on a continuum between any given two requirement types, the problem becomes one of limits and sensitivity. Limits are necessary to arbitrarily resolve at least some of the grey areas back

into black and white. Sensitivity analysis is necessary to determine how much of a specification analysis is covered by classical fits and how much arbitrarily moved out of a grey area. Table Seven shows the count made on one project concerning classical fits to the taxonomy categories. The table is a device to present the subjective judgement made concerning requirement type fits, and the appearance of precise numbers and percentages should not carry more weight in the mind of the reader than intended. What the table is intended to show is that somewhere around one quarter of observed requirements are not clearly associated with any taxonomy element. Previous to this evaluation, there was another effort to arrive at the total number of requirements (both classical fits and grey ones) on the initial program seen. One must assume some form of learning would take place in requirement counting which would make a later count of a specification's requirements different from the first one. Table Eight shows the results of three sequential counts on the initial project. As can be seen, the second and third measures are substantially closer than the first and second. It is recognized that this argument suffers the same weakness as attributed to a Delphi process, namely that convergence of subsequent findings does not necessarily support any

TABLE SEVEN
EVALUATION OF REQUIREMENT TYPES WHICH FIT
CLASSICAL DEFINITIONS IN ONE PROJECT

TOTAL NUMBER	11	63	286	39
NUMBER OF FITS	9	37	214	24
PERCENTAGE	.82	.59	.75	.62
	MISREQ	OPCHAR	DERSS	INTERFACE

TABLE EIGHT
REQUIREMENT COUNTING LEARNING CURVE RESULTS

MEASURE ONE	11	48	226	46
MEASURE TWO	11	60	271	39
MEASURE THREE	11	63	286	39
	MISREQ	OPCHAR	DERSS	INTERFACE

conclusion about the appropriateness of the mean converged upon.

Basic Regression Relationships

The basic equations for both bivariate and multivariate relationships are listed in Table Nine. Listed along with the equations are relevant statistical results.

The bivariate relationships show little direct correlation with time. High correlations are found between Operational Characteristics and Interface Requirements ($R = .95727$) and between Mission Requirements ($R = .86721$).

The multivariate relationships are uniformly high. Mission Requirements are determined from the other requirement types with an R square of .86689. The significance, as given by the F test, is better than .0001. Individual coefficients passed the T test for significance. Both the Von Neumann and Durbin-Watson tests indicate no auto-correlation.

The operational Characteristics are determined with an R square of .95920 and enjoy the same statistical support except for a Von Neumann Ratio of 1.78642 which indicates possible autocorrelation. The Durbin-Watson test is contra-indicative, however.

TABLE NINE
SELECTED COMPUTER RUNS - BASIC EQUATIONS
AND STATISTICAL RESULTS

COMPUTER RUN WITH ALL TAXONOMY ELEMENTS (APPENDIX EIGHT)

Correlation Coefficients

OPCHAR	.47420			
DERSS	.86721	.76490		
INTERFACE	.45174	.95727	.69115	
TIME	.01438	.34225	.14226	.34604
	MISREQ	OPCHAR	DERSS	INTERFACE

Multivariate Relationships

Mission Requirements

MISREQ=.069 DERSS-.206 OPCHAR+.856 INTERFACE+1.052

R square=.86689
 F=121.56 Significance=0
 Standard Deviation=.01257

Opererational Characteristics

OPCHAR=.542 INTERFACE=.156 DERSS-1.721 MISREQ=2.035

R square=.95920
 F=438.86 Significance=0
 Standard Deviation=.03635

Design Requirements

DERSS=11.860 MISREQ+3.191 OPCHAR-1.237 INTERFACE-12.8

R square=.93220
 F=256.66 Significance=0
 Standard Deviation=.16425

Interface Requirements

INTERFACE=1.568 OPCHAR-.175 DERSS+2.069 MISREQ-2.472

R square=.93452
 F=266.41 Significance=0
 Standard Deviation=.06184

TABLE NINE
(Continued)
COMPUTER RUN WITH INTERFACE REQUIREMENTS
AND OPERATIONAL CHARACTERISTICS COMBINED
(APPENDIX TEN)

Correlation Coefficients

DERSS	.86721		
OPINT	.46223	.73030	
TIME	.01438	.14226	.34808
	MISREQ	DERSS	OPINT

Multivariate Relationships

Mission Requirements

$$\text{MISREQ} = .062 \text{ DERSS} - .030 \text{ OPINT} + .997$$

$$R \text{ square} = .81189$$

$$F = 123.0 \quad \text{Significance} = 0$$

$$\text{Standard Deviation} = .01428$$

Operational/Interface Characteristics

$$\text{OPINT} = .870 \text{ DERSS} - 8.158 \text{ MISREQ} + 9.390$$

$$R \text{ square} = .88780$$

$$F = 51.997 \quad \text{Significance} = 0$$

$$\text{Standard Deviation} = .24607$$

Design Requirements

$$\text{DERSS} = 12.317 \text{ MISREQ} + .630 \text{ OPINT} - 12.576$$

$$R \text{ square} = .88780$$

$$F = 225.58 \quad \text{Significance} = 0$$

$$\text{Standard Deviation} = .20940$$

NOTE: The combined variable Operational/
Interface characteristics is repre-
sented by the acronym, OPINT

Design Requirements are determined with an R square of .93320. Here, again, the main disturbance in the supporting statistics is a mixed autocorrelation test.

Interface Requirements show an R square of .93452 and a good autocorrelation test with a Van Neumann Ratio of 2.00295 (2.0000 being the expected value).

Particular Relationships of Interest

The first area of particular interest is that of the high bivariate correlations. These are the first indication of multicollinearity. Beyond giving valuable insight on the requirement type relationships, this finding's primary importance lies in its capacity to potentially confound meaningful use of the multivariate relationships. The high correlation between Operational Characteristics and Interface Requirements ($R=.95727$) is simply explained and corrected. Strayer and Lockwood's original taxonomy which made no distinction of Interface Requirements from Operational Characteristics is supported by this finding. Further Support is found when one analyzes the variance/covariance matrix for one of the multivariate regressions involving these categories as independent variables. Table Ten shows such a matrix for the dependent variable Mission Require-

TABLE TEN
COVARIANCE TABLE FOR MISSION REQUIREMENTS

(Demonstrating the Close Relationship between
Operational Characteristics and Interface)

OPCHAR variance	.00138
INTERFACE variance	.00061
COVARIANCE	.00084

ments. The strength of the covariance outweighs the Interface variance and is better than sixty percentum of Operational Characteristics variance. The recombining of the two covariant variables into a single Operational/Interface Characteristics variable was done and is shown in Appendix Eleven. Selected statistics lifted from that computer run are shown in the last half of Table Nine.

It was suspected that the computer run with the combined Operational/Interface Requirement variable (Appendix Eleven) would not alter significantly the high bivariate relationship between Mission Requirements and Design Requirements, and this was found to be true. Table Eleven shows that relationship. The covariance between the two variables is seventeen times that of the Design Requirements variance. Unlike the case of Interface Requirements, there is no ready answer for this observation.

Two streams of thought must be explored in searching for an answer. Either there is something in the data or data analysis which is distorting the model, or the model is accurate and a logical underlying reason exists. The data collecting procedures were reviewed and the analysis of requirement fits to classical definitions (Table Seven) was considered. The greatest chance for error in classifying requirements is in the intermediate categories of Operational Characteristics and Interface Requirements as each has a conceptual overlap with two other requirement types. One of those overlaps is with each other, which has been shown to be pronounced. The two end types, Mission Requirements and Design Requirements, are the easiest to define. The

TABLE ELEVEN
COVARIANCE TABLE FOR OPERATIONAL/INTERFACE CHARACTERISTICS

(Demonstrating the close relationship between
Mission Requirements and Design Requirements)

MISREQ variance	3.6709
DERSS variance	.0110
covariance	.1739

likely place for making an error having such an impact is in Mission Requirements because of its small numbers. This, however, is the easiest category of all to isolate and count. The data counting procedure was dropped from further consideration. The smallness of the Mission Requirement numbers may cause the category to suffer distortions in the statistical processing used. A requirement change on the base one hundred is a one percentum change. Done on the base ten, however, it is a ten percentum change. If a counting error occurred in Mission Requirements, the comparison of raw numbers, while being distorted, would probably not be fatal. When this same data is transformed to a rate of growth, the error is magnified. Since the requirement categories measured exhibit a difference in numbers approaching one order of magnitude, the possibility exists. Mission Requirements, both conceptually and observed in most projects exhibit no growth from the initial number. A number erroneously chosen at first, will stay with the rest of the counting. The potential for errors which affect growth rates lies in counting the increased Mission Requirements above the established base whether it was counted properly or not. If there is an error, it is likely both conceptually and procedurally to be an

unwarranted increase in the growth rate. Following this logical premise leads one to question just how far away from zero growth the Mission Requirement observations were and if that difference was significant. The difference does not appear large, but one must suspect the sensitivity of a small sample. This sensitivity analysis can be done by assuming the conceptually postulated zero growth for Mission Requirements and running the computer program with this input. If correlation is still high between the two requirement types in this analysis one must seek the answer somewhere else than with Mission Requirement counting of analysis techniques. When this is done (see Appendix Twelve) one sees that the R square drops from .86721 to .79696 reflecting that the vast majority of correlation cannot be related to Mission Requirement errors. It would seem logical at this point that some underlying conceptual reason should be sought.

Three Most Significant Findings

The three most significant findings concerning requirements are:

- 1) the taxonomy received support as an indicator of central tendencies, but there is a large number of poor fits in each category except Mission Requirements;

- 2) no support of bivariate relationships between time and requirements is seen, and
- 3) an unexplained correlation between Mission Requirements and Design Requirements makes, what originally looked like good multivariate regressions, questionable.

The finding that a theoretical taxonomy of requirement types is evident in existing specifications is a positive inducement to continue refining the counting process. Partitioning of the total set of requirements into logical groups is the first step in understanding and controlling requirement growth. Basically put, common requirement types and patterns lead to common solutions.

The finding that bivariate relationships are not strong over time is significant to the assumption of orderly growth. Mission Requirements were expected to be time independent but the other types were expected to have, at least, fair correlations with time and increasing slopes as they progressed through requirement types towards Design Requirements. Both the correlations and slope coefficients of Operational Characteristics and Interface Requirements, while hovering in the .30 range, are not quite in the range expected. The Design Requirement slope coefficient and correlation are clearly not as predicted, being on the same order as Mission Re-

quirements. Some other conclusion than direct and strong relationships of the Mission Requirements causal theory must be considered unless the apparent inconsistency can be cleared.

The unexplained correlation between Mission Requirements and Design Requirements is significant because it indicates a direction to search in seeking an explanation to the apparent inconsistency.

CHAPTER SEVEN - - IMPLICATIONS OF THE RESEARCH

The assumption of orderly growth had been established from long standing observation. These observations included the recognition that when a project starts to take shape in the conceptual stage, the type of requirement is almost always Mission Requirements with some gross Operational Characteristics. It is known that a project near completion exhibits a clear majority of Design Requirements with a lesser number of Operational Characteristics. These observations led to the logical premise that more detailed requirements grow from less detailed ones in a decision tree type of pattern.

The correlation of Design Requirements with Mission Requirements and the lack of correlation of either of these to Operational Characteristics makes this proposed pattern unlikely without some modifications.

Possible Alternate Explanations

As the computer run with Mission Requirement growth set to zero showed, the apparent correlation between Design Requirements and Mission Requirements is not caused by Mission Requirements acting unpredictably. A profile of little or no growth is assumed and the data supports it. Design Requirements are postulated to

have the greatest growth, but its pattern is actually indicative of the Mission Requirement low growth profile.

One good reason for low Design Requirement growth might well reside in the use of specifications. Specifications are primarily descriptive documents which show the status of a project's development at some point in time. Specifications are also referenced documents which show the status of a project's development at some point in time. Specifications are also referenced documents on research and development contracts. As such, new or changed specification requirements carry the potential for a change in the agreed effort to be accomplished by the contractor. This effort is defined in the contract statement-of-work which is written in general terms to allow some flexibility for design in conditions of uncertainty. Changes in the statement-of-work normally carry with them cost and schedule increases. These are anathema to a well run project. The specification analog to loose statement-of-work statements is the use of Operational Characteristics. It is possible that cautious managers substitute Operational Characteristics for Design Requirements in their evolving specifications as often as feasible. Operational

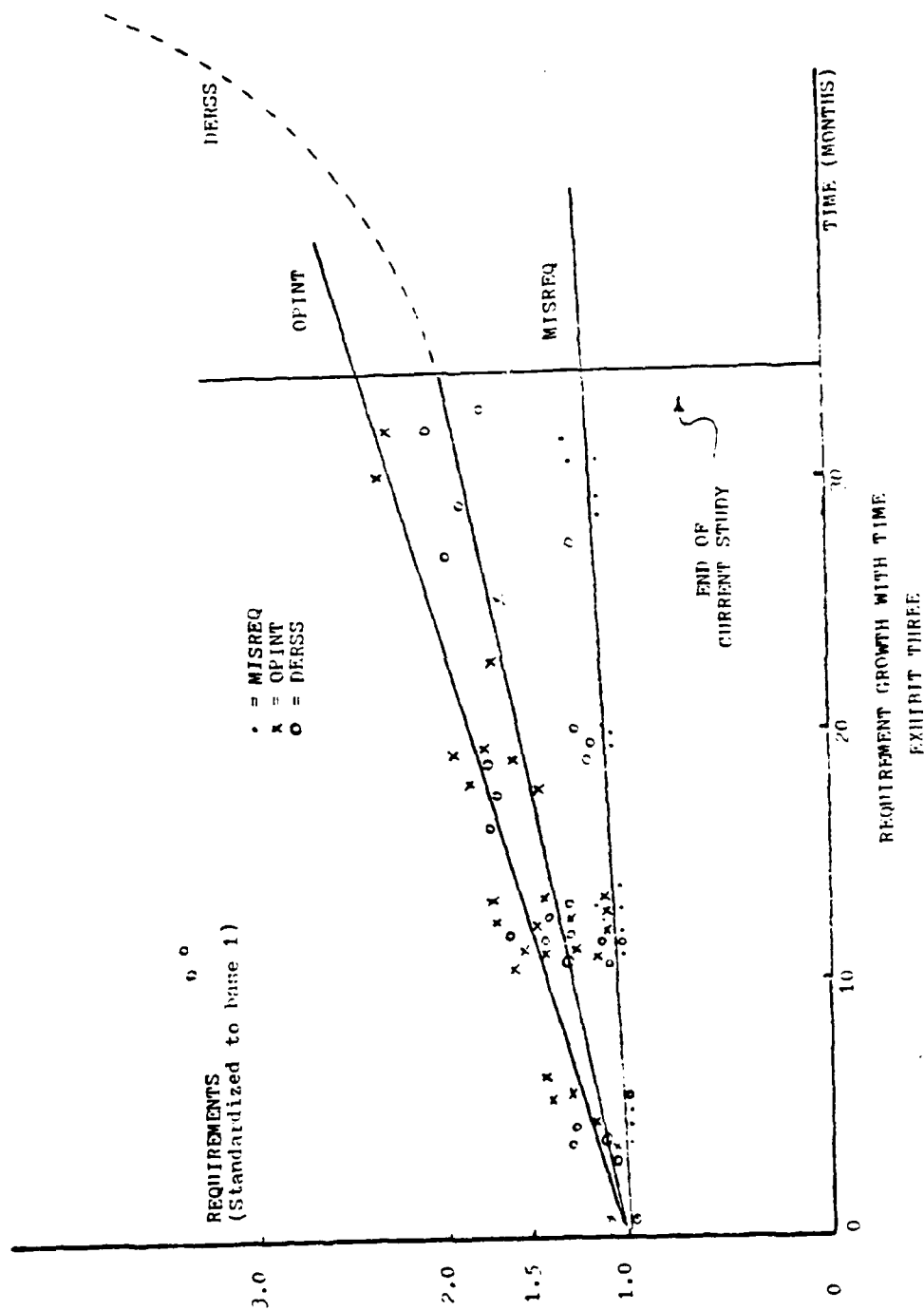
Requirements can usually be met by a variety of Design Requirements; Design Requirements are highly constraining. Since the Design Requirement is normally expected to be the last category of requirement completed, a strategy of filling in the spaces in an evolving specification with relatively flexible Operational Characteristics and of holding off Detail Requirements as long as possible can be used and still give the appearance of a well run and orderly development.

Interface Requirements were originally evaluated because it was believed that an increased level of detail, as a Part One specification evolves, would force resolution in key areas by Interface Requirements. Interface Requirements put Operational Characteristic constraints on one side of an interface. The increase of Design Requirements makes one half of many interfaces firm. This is properly balanced by an increase in Operational Constraints on the yet to be resolved side of the interface. Although Design Requirements did not grow as anticipated, neither did Interface Requirements which conforms to the understanding of the relative relationship.

The problem of interface is thus also apparently controlled at the Part One level by staying with Operational Characteristics as long as possible. Acceptance

of this explanation of the early substitution of Operational Characteristics for Design Requirements and Interface Requirements as the fastest growing category is inconsistent with the originally conceived pattern of growth for each of the categories but does not rule out some type of order in the growth.

When one works with linear regressions in a specified range of inquiry, the natural tendency is to consider extending the regression outside the range. There is one assumption of growth which will make the observed results generally fit the conceptual model but it requires extrapolation of Design Requirements in a curvilinear pattern. Exhibit Three shows this construction. Design growth may be retarded in Part One specifications because of reasons previously given. At the beginning of the Part Two specification, Design Requirements would take off, making the combined Part One and Two pattern reflect an exponential curve. The Part One pattern might be so flat that small samples would parallel the results of a linear relationship. Examining the relevant range of Exhibit Three, one could therefore suppose a high correlation between the apparent straight lines of Mission Requirements and Design Requirements. The observed correlation is .86721. One would suppose



that since these two categories don't grow much, their correlations with time would be small. The actual correlations with time are .01438 and .14226. One would expect the very least correlation with time to be for Mission Requirements. This is true. Once Design Requirements are assumed to grow exponentially, one would expect Operational Characteristics to show the greatest growth in the relevant range. The actual correlation is the best at .34225. Lastly, one would expect all of these relatively flat lines to relate well with one another which is reflected by the high multivariate relationships.

The model in Exhibit Three proposes a slightly altered but conceptually valid demonstration of orderly growth. It accounts for the apparent conflict between theory and observation of Design Requirements growth by showing how a low measured growth and high perceived conceptual pattern can be reconciled in the relevant range of observation. It is recognized that the leap from research findings to this possible alternate explanation is a leap forward from the data analysis but the conceptual jump is small and supported by observations of the interrelated patterns among the requirement types.

CHAPTER EIGHT - - SUMMARY

In military projects, goals are represented by technical requirements in development contracts. Process is represented by various other contractual requirements and by the management systems in force. A review of public administration history has shown that, through a process described as functional rationalism, the bulk of America's public agencies have lost their perspective on goals because of their preoccupation on the processes used in gaining those goals. Air Force projects constitute a special form of public agency and they evidence manifestations of this common problem.

Specifically, Air Force history has shown a proclivity to rationalize development of a project into formal phases in a life cycle, and to further manage each of these phases according to a series of manuals and management systems. As in the generalized case for public administrations, the harm done is not seen to be inherently incorporated in the particular systems, manuals and life cycle phases but rather in the resultant lack of attention on requirements.

Direct academic research on technical requirements has been scarce. Early studies were marked by emphasis of the uncertainty and complexity inherent in

technical projects. The main thrust of such studies was that the marked uncertainty and complexity of weapon system acquisitions clearly differentiate those efforts from developments in the private sector.

Some writers classified the more important requirements as "technical performance parameters" and proposed systems for their control. Others traced the specific effects on programs of uncertainty and complexity to external and internal sources and emphasized controlling these factors.

Martin, in his 1971 dissertation, used an entropy analog to analyze the amount of information (and accordingly decision alternatives) in a project development. He related this entropy (defined as a measure of the information in a system) directly with the increasing amount of information in a project development and argued that more information inherently meant more choices hence more uncertainty. This led to his adaptation of the second thermodynamic law which says that the tendency exists for a system's entropy to always increase.

Martin's use of an increasing information base appears to be an abstract counterpart to the evolving technical requirement baseline and thus his dissertation is one of the few efforts which addresses requirement

growth directly. Its focus, however, is a "grand scheme" explanation of how uncertainty operates on a highly generalized information (or requirement) growth network. This doesn't allow isolation of specific types of requirement growth.

Following Martin's lead, an analogy to learning theory was investigated. The investigation did not provide a readily usable framework, as it did in Martin's case, but it served to sharpen the perspective on what should be studied. Learning theory contains two basic, and not completely compatible theories on learning. The Wundtian Elemental school forwards the proposition that items are learned and remembered independently of associations with other ideas. The rote memory work of multiplication tables, spelling tests and the like attest to the widespread application of such a learning theory. The Gestalt school, however, believes that learning and memory depend on interaction of the items in question with other already learned items. One must satisfy himself as to the logical relationship in order to remember. Perhaps the best current example is the association methods taught in memory classes for remembering names and places.

In weapon system acquisition, heavy emphasis

has been placed on the role of complexity in making such developments difficult. This complexity has been shown to grow, in part, as the unanticipated result of combining two requirements which are themselves simple. Thus a synergy effect occurs where the resultant complex problem is greater than the sum of the individual problems. This characteristic is analogous to a Gestalt process where the whole of a problem is more than the summation of its parts, but rather a summation of parts plus associations. Following the lesson of this Gestalt analogy to its logical conclusion, one is led to realize that technical requirements cannot be understood in isolated categories.

The terms "military project" and "weapon system acquisition" have previously been used interchangeably and without further definition. This was done primarily to gather under one roof all of the diverse writings and research in the field which run a gambit from big programs to small projects and from Navy to Army to Air Force.

The conceptual model uses the aggregate comments based on definitions using any one or a combination of these terms to explore the historical development and background. The comments give a direction to search in

making the conceptual model, but if one is to go further, a more precise definition is necessary. The conceptual model uses the technically oriented project offices of the United States Air Force. Each such project office controls the development of a product by one or more technical contractors using development contracts. These contracts include a set of requirements, described by Strayer and Lockwood as:

- 1) Mission Requirements - - basic statements of product mission,
- 2) Operating Characteristics - - basic functional statements,
- 3) Design Requirements - - details on design and specification compliance,
- 4) Interface Requirements - - added to the Strayer/Lockwood list as functional statements that constrain the interface between two requirements,
- 5) Management System Specifications - - basic management systems,
- 6) Legal Obligations - - Walsh-Healy Act, etc., and
- 7) Programming Requirements - - schedule and funding arrangements.

Each product controlled by a project office is technically defined by the first four requirement types. Control is exercised over a product's development life cycle which includes conceptual, validation, full-scale development, production and deployment phases.

The conceptual model proposes that the various technical requirements are present in commonly used development specifications and that requirements can be isolated and counted such that an aggregate number in each category can be totaled. Further, the model proposes that there is a discernable bivariate trend of growth for each requirement type over time and therefore necessary multivariate relationships as well. The specific patterns of growth are postulated to be linear or a transform function. Specifically, Mission Requirements are seen to remain relatively steady over time. Operational Characteristics are seen to exhibit some growth, Interface Requirements more, and Design Requirements the most.

The case is centered on the validation phase of a project's life cycle. The document selected is the part one Critical Item Specification. The research site is selected as Wright-Patterson Air Force Base in Dayton, Ohio. Projects were selected in avionics because of researcher familiarity with the subject. The number of projects evaluated was established at seven.

Since the thrust of the research is on the common aspects of requirement growth, the identification of requirements by project was relaxed to allow all require-

ments of a particular type to be summed together. This increased the sample size by allowing time to be the one common denominator among samples.

Research findings were not total support of either the process of requirement counting or the conceptual model on interrelations. Requirement types seen in Part One specifications are sortable by category, but the overlap between types is large and discourages precise use of the results. The bivariate relationships of the requirement types with time are not fully in line with the conceptual model in the relevant research range. This range, it should be remembered, is the period of development of the Part One Critical Item Specification in the acquisition phase of a product's life cycle. During this period, Mission Requirements and Design Requirements seem to have highly common growth patterns. The two are highly correlated with each other. The two have commonly low correlations with time. They have similar slope coefficients. The circumstance of common slope coefficients is important because it strikes directly at the heart of the differential growth hypothesis. Design Requirements were thought to have the most different not the most common slope with Mission Requirements. It is statistically inappropriate to depend on a comparison of common slope coefficients where correlations are so low. The conclu-

sion of common slopes, as seen in the computer results, was accordingly supported using a different approach.

Design Requirements show a high bivariate relationship with Mission Requirements. This means that sufficient linearity exists between the two that one can predict the other with high certainty using a direct mathematical relationship. Going a step further, if one can accurately be measured against time, so can the other. This establishes common tendencies of linearity with time for the two variables, but it does not establish the occurrence of common slope coefficients. Further, the common tendency with time, so far, has been seen to be one of low correlation. Addressing this low correlation with time, the Mission Requirement correlation was seen to be low because the data points parallel the X axis, not because of a wide spread of data points. In essence, the data support a strong linear relationship and a well defined slope for Mission Requirements which is truly not correlated with time in that no matter how much time elapses, Mission Requirements are not seen to grow. The high correlation between MISREQ and DERSS accordingly takes a greater significance. Further, evaluation of the Design Requirement data points confirms that they also follow the low scatter, low slope profile of Mission

Requirements. This analysis supports the computer findings of relatively common and low slopes for Mission Requirements and Design Requirements. As again evidenced in the high multicollinearity between Mission Requirements and Design Requirements in the multivariate relationships, Design Requirements are inappropriately related. By using the explanation of an exponential or other sharply rising change in Design Requirements during the Part Two specification development, the study results can be reconciled to a conceptually sound growth theory.

This points up both the limits and the value of this dissertation's results. The research concludes that requirements can be counted and that the simplest model of differential linear growth of requirements in Part One specifications is not valid as postulated. In keeping with the dictum of Occam's Razor- the simplest set of assumptions needed to explain a phenomenon is best- a single change is proposed as a target for future study. Such a future study should start with a validation of the requirement counting process. Appendix Three gives a proposal for doing this.

CHAPTER NINE - - RECOMMENDATIONS FOR FUTURE STUDY

A major purpose of this dissertation is to provide a way for counting, and possibly sampling requirements. Hopes for sampling have been dimmed by the research results because of the apparently large overlap between requirement types. It is possible that more can be done to crystalize the categories such that the overlaps will diminish. To this end, Appendix Three is written to offer suggestions as to how a study of this type might proceed.

In the area of requirement relationships, the obvious first step is to check part two specifications to see if Design Requirements take off in an upward direction as suggested by this research. Other alternatives also follow obvious forms. Expansion of the study across a wider base of avionics is the first step. This serves as a validity check on the results already accomplished. After that, extension to other functional areas can be considered. As sophistication in the counting and analyzing process increases, the research can be extended to large programs where specifications have a lot of interaction among themselves.

No evaluation of the requirements growth process

would be complete without more than passing attention paid to deliberately constraining growth. Interviews with numerous project leaders and staff elicited a common belief that those requirements developed early in acquisition should be held firm. One author¹ emphasizes the early involvement of contractors in writing system specifications as one way to insure that changes are minimized.

Other authors² continue a written track of the project managers' consensus on control of growth. They list several "errors" of management. Setting requirements without user involvement is the first type of error. Their subsequent list of errors generally involves changing those requirements without user involvement. Lack of involvement of the using military commands (Tactical Air Command, Strategic Air Command, etc.) is a relatively recent criticism. In fact, the counter complaint that user involvement led to unnecessary changes led to an emphasis on reduced command influence as a cornerstone of the McNamara era. Acceptance of user inputs does not necessarily mean unnecessary requirements, however. The wisdom of what original requirements to hold fast in the face of a rapidly changing environment must take account of the experience of those forced to live (or die) with

results. This research can serve to make the distinction of requirement types more clear and emphasize the large scale implications of changing Mission and high scale Operational Requirements.

CHAPTER NINE ENDNOTES

1. See Dietrich's article "System Acquisition - How A-109 Can Help Shorten the Process" in Government Executive, Volume 9 (Bibliography number 10).
2. Reference Ferratt and Starke's article "Avoiding System Mismanagement" in Journal of Systems Management, Volume 29 (Bibliography number 12).

APPENDIX ONE
BACKGROUND RESEARCH SOURCES

APPENDIX ONE
BACKGROUND RESEARCH SOURCES

The subject of technical requirements growth came as a spin-off to an original interest in control of engineering changes. As a technically complex weapon system is developed, changes to the design are inevitable. These engineering changes are damaging to a program not only because they are inherently costly, but also because they often stretch a development schedule which allows the dual problems of idle engineering capacity and inflation to operate.

One must know precisely the base of requirements at any two points in time in order to properly evaluate the engineering changes occurring between those points. The addition of a new requirement is not a legitimate change. Further, it is probable that the differences in absolute numbers of requirements between programs inherently leads to differences in engineering changes. Larger programs likely have more changes. These two conclusions make it necessary to accurately measure requirements in order to understand engineering changes.

It became immediately apparent that even a sketchy understanding of requirement isolation and counting did not exist. Tracking this problem led to

researchers concerned with the problem and to their organization, the Air Force Business Research Management Center located at Wright-Patterson Air Force Base in Dayton, Ohio. This center was established to coordinate and evaluate research in business oriented procurement methods. The researchers in the center specialize in different functional areas and broker research in their specialty to different Air Force students and agencies. When an avenue of research is particularly promising, funding for private research is considered. Technical requirement growth is the concern of both the center's chief, Lieutenant Colonel Daniel Strayer and of Captain Lyle Lockwood. These two have a good balance of academic background and practical experience. Their paper on the subject called "What Are We Buying Here?" is the basic foundation of the dissertation because of its proposed taxonomy. Beyond this vital research done by Strayer and Lockwood, another resource offered by the center was the collateral studies, many of which are documented in the center's Semiannual Business Research Reports. Using this document and reports suggested by the center staff, the serious work of tracing the background of technical requirement growth research was begun. The process started here is standard in academic

research and involves tracing the bibliographies of relevant documents to other pertinent documents and continuing the process until good sources are exhausted.

This line of research using the center's resources led to the nucleus of research reports and studies for the dissertation.

Two other major resource centers are located at Wright-Patterson Air Force Base. The first is the library of the Graduate School of Logistics. This library is important to the dissertation because it is an Air Force access point to the Defense Logistics Studies Information Exchange. Using the Exchange's descriptor list, a bibliography was established and reports ordered.

The second center is the Air Force Institute of Technology's Engineering Library. Dissertation Abstracts International, while not an exclusive resource of this library is a necessary one to review and is available there. The areas of Business Administration and Systems Management were found to be the most fruitful and were reviewed for similar dissertation topics - - none were found. One almost has to live in the environment of technical engineering management to undertake such a topic so the lack of close subjects was not surprising.

Air University Abstracts of research reports was

reviewed for topics using the categories of System Management, Requirements, Technical Performance Parameters, System Program Management, and Project Management.

Two other sources in the library are the International Aerospace Abstracts and the Keyword Index of AFIT Student Resident Theses. These sources are marked by the fact that the respective bibliographies are not computerized so that they must be entered using keywords and do not allow combinations.

Other sources are more individually tailored. The University of Texas at Austin's computerized search of journals and periodicals called INFORM was run. The Defense Documentation Center's computerized bibliography was used as well as that of the National Technical Information Service.

The general library facilities of The University of Texas at Austin were used. NASA/SCAN sheets from the National Aeronautics and Space Administration were reviewed and the 81-01 series of Aerospace Management was found to be the best source. Papers and books recommended by committee members were used.

APPENDIX TWO
REQUIREMENT CLASSIFYING AND COUNTING PROCEDURES

APPENDIX TWO

REQUIREMENT CLASSIFYING AND COUNTING PROCEDURESAssumptions Made in Counting

It is immediately apparent that some of the requirements seen in a part one specification are included more than once. This practice is generally accepted because of the dual nature of specifications. They serve as technical guidance and description, on one hand, and a contractual standard of performance on the other. Requirements are often specified in some places primarily to add context to other requirements but must be repeated later, in the appropriate place, to assure contractual coverage. This repetition is small compared to the total number of requirements and is ignored in the research.

Many standards for design and testing are codified in various Department of Defense specifications and standards used by the Air Force. Each such specification is designed for common application across projects, and hence, compliance over time evokes standard responses to design, test procedures, etc.. Each such standard is assumed to be in the government system if it is listed in the latest Department of Defense Index of Specifications. Each such specification or standard is treated as one requirement each time it is reference in a specification.

Procedures

What defines a single requirement? This problem is easy to answer in concept but quite difficult in practice. One should remember that the complex nature of requirements makes statement of relationships and interfaces into compound statements, sometimes involving many parts in order to properly reflect the complex nature of the relationship. One alternative to simplify this situation is a structural content approach. This leans on the idea of sentence diagramming rather heavily. It breaks each sentence into parts and analyzes those parts. The following sentence is presented for analysis:

The Omega Air Navigation System shall operate at the low-frequency wave lengths in communicating navigation information between aircraft and ground stations over long distances.

In the above sentence, "Omega" is simply a name, yet it is now a government-required label for the system. "Navigation" is a requirement as to function, albeit gross. "System" requires that there be interrelated components of large enough size to warrant being called a system instead of simply a unit. "shall operate" is a requirement for use of the system - - as opposed to only requiring a system mock-up. "low-frequency wave lengths" defines the means of transmission as radio (as opposed to laser, for instance) and it further constrains that operation to

be in the low frequency band. "communicating", when used in conjunction with "between", requires two way transmission. This means that both a transmitter and receiver is required. Since we have already assumed a receiving capability inherent in navigation by radio, this has added a transmitting requirement. "navigation information" is a direct output of already required navigation system operation, hence the phrase adds nothing to the sentence beyond better context. "aircraft and ground stations" denotes a specific environment in which the communication will occur. "over long distance" levies an operational requirement which will ultimately be reflected in transmitter power requirements and receiver sensitivity.

When one analyzes the process he recognizes that the significance of each phrase was very critically evaluated. One can quickly grasp the magnitude of a task which requires treatment of every sentence in a book-sized document in like manner. Further, the absurdity to which one is reduced is much like a psychiatrist performing an in-depth analysis of a person based on how he said "Good morning". No single sentence in a specification is intended to stand so alone that interpretation out of context will always be clear. This alternative reflects the age old error in logic - - mistaking precision for

correctness. The missing ingredient to this analysis is context. Once the context in which the sentence was written is established, the sentence can again be evaluated, but with a filter to screen out unwarranted nuances of meaning. Analysis of the above sentence from the context of its being an introductory statement would lead one to search for aspects of Mission Requirement in the statement. Thus the system is seen to have a requirement for long range air navigation using ground stations. While this approach lacks the precision of the previous approach and requires experienced judgement to apply context to the sentences, it is the best reflection of what the specification writer intended.

Use of the Procedure

A necessary first step in implementing the procedure is evaluation of the specification table of contents which outlines the hierarchy of the subject covered. Some specifications have a more detailed outline than others, and these are usually less likely to have amalgamated paragraphs of diverse subjects than the less structures specifications. Close evaluation of the specification hierarchy gives necessary insight into subject context, so vital in counting requirements in any given sentence. Once the hierarchy is known, a brief survey of the con-

tents should follow to gauge the number of graphs, tables, blank paragraphs and other features likely to make the specification atypical.

Classifying and counting requirements are two conceptually different functions which tend to merge when one becomes familiar with the process. Each sentence can be broken down into a number of candidate requirement statements without regard to type. This process leans heavily on the context of the statement for guidance. Once candidates are separated, the valid requirements are typed. Many requirements statements are not complicated and this process is not difficult in those cases. There are many complicating factors, however and these must be addressed.

Paragraphs which consist of a heading only, in order to reserve a space in the specification outline, are not counted as a requirement.

Sentences and paragraphs marked "to be determined" are not counted.

Items on the list of applicable documents found in the front of specifications are not counted, since they must be specifically referenced in the body of the specification. Their appearance here is only for reference.

Each reference to other system or Critical Item

Specifications is counted as one requirement.

Tables which array data in a matrix form shall have each cell count as one requirement.

Functional diagrams showing interfaces between components shall reflect each arrow which denotes interface as one requirement. Ancillary notes on the diagram are counted just as if they were text.

Graphs with points plotted on a two dimensional scale shall have each point count as a requirement. Where there is an outside boundary or performance envelope, it shall count as one additional requirement.

Revisions to specifications are made periodically. These revisions are not always reflected as totally revised documents but rather as revision notices attached to the original document. If such a revision notice is used to establish new requirement type numbers, care must be taken to insure that net changes in number are sought rather than the number of revisions. Some revisions change an already existing requirement which would total one revision but a net of zero new requirements.

Operational Characteristics are generally functional statements, while Design Requirements relate to attributes possessed by an item. Although the distinction is not always clear, anything expressed in terms of

quantities generally measures an attribute and is therefore a Design Requirement.

Relationships between Design Requirements are never Interface Requirements.

Wiring diagrams which include attributes such as voltage are Design Requirements.

Product requirements which relate to test conditions or environment are Design Requirements.

APPENDIX THREE
A PROPOSED FUTURE REQUIREMENT COUNTING STUDY

APPENDIX THREE

A PROPOSED FUTURE REQUIREMENT COUNTING STUDY

Introduction

If evaluation of the requirement counting procedure had resulted in clear and objective standards, then replication of the procedure would have been simple. The dissertation concludes, however, that some form of bounded subjectivity is the best one can ever do when counting requirements. A crucial question thus remains as to whether the subjective decision process can be sufficiently bounded to give usable and repeatable results. The crux of this issue is not whether one unique person can replicate his own results, but rather if a group of qualified researchers can do it.

This appendix describes one way in which consensus among such researchers might be gained. The goal of the research is to produce replicable results in a specification requirements counting process. Since subjectivity is woven into fabric of the problem, more than a list of rules is anticipated as outcome. First, there must be such a list to bound subjectivity as much as can be done. Secondly, however, insights into classes of problems encountered is necessary.

Study Group Constitution

It is obvious that the study group members must be already familiar with the military research and development processes to be effective. The more current a member's experience, the more useful it will be.

The investigation must be rooted in good analysis procedure. The disciplined approach required for such a study is traditionally required of graduate students. The group is envisioned to contain three students. Although group consensus represents the optimum support for a resultant group finding, it is recognized that this does not happen for every point and thus a tie breaking number is selected. The specific operations of the group is not a necessary subject for extensive prior definition since the group's size is small enough to allow group procedures to conform to differences in member personalities. Agreement on the time frame, support functions such as typing, and conflict resolution procedures should be squared away as soon as possible.

Group Dynamics - - The Learning Process

Reading and discussing this dissertation and the included requirements taxonomy is the first step. This is primarily an individual effort with the supervising professor acting as coordinator. Use of the dissertation

gives every member a common base of departure in evaluating the taxonomy. Each member should independently write his questions and criticisms of the material and submit them to the supervising professor. Independently derived inputs might well overlap but it gives the best chance for a wide perspective. While consensus opinions derived from group processes are sought at the end of the research, they should be discouraged early. The supervising professor will sort the comments and questions and put together an aggregate agenda for the first group discussion. The first discussion group is aimed at the non-specific goal of merely understanding the requirement categories and how they relate. This might require more than one meeting, but the group should resist going on without completing it. One member should act as secretary and document unresolved issues and agreements alike. When the group thinks it understands the separate requirement types, it should propose an initial process for counting them.

Group Dynamics - - The Synthesis

Classically, thesis and antithesis meet and result in a synthesis. In this case, the study group has developed its own thesis from a critique of the dissertation. Antithesis is embodied in the confrontation of an

actual specification with the thesis. The synthesis should be a more usable requirements counting procedure and possibly some enlightened comments on the process. The actual specification given should be carefully selected. It should reflect the common characteristics of current specifications. It is not prudent to start evaluation with the most atypical specification but rather the study should build slowly from the most common base to various types of atypical specification (too many graphs, lack of clear product hierarchy, etc.). The first evaluation of these specifications should again be individual effort. In effect, this makes three embryonic first syntheses instead of one. The first point of comparison would then be between each study member's raw total counts in each category. This is appropriate because the ultimate test of repeatability lies in the raw number counts.

This process will lead to new procedures and insights which should be separately recorded. One should resist trying to tie insights from each iteration together until later in the study in order to leave large latitude for developing threads of thought without imposing preconceived patterns on the data. The process should proceed through first synthesis to two more iterations

using different parts of the target specification in each case.

Study Results

At this point, the threads of insight about classes of problems and exceptions to procedures should be traced and major conclusions made. A final test of the procedures should be made by evaluating, once again, the original specification section which had been evaluated only that once. Enough time should have transpired by now to have negated any originally patterned thoughts. Analysis of the variances from the original data counts for each requirement category can be accomplished. The greatest change in numbers should reflect the greatest conceptual shift. This avenue should be explored and compared to the major insights derived independently. Convergence of one or more student's final count on another's original count might reflect the presence of a strong personality rather than a logical shift. The primary test will be to see if the spread of raw data counts in each original requirement category was reduced significantly in the final count between the researchers and if the reduced spread is explained by the changed procedures and insights. This last requirement is vital since any group of people

working together over a period of time on one subject will probably see their thoughts converge. Only those convergences that can be expressed in revised procedures and clear insights can validly be considered as affecting the general ability of the requirement counting process to be replicated.

APPENDIX FOUR
PROJECT SOURCE DATA

APPENDIX FOUR
PROJECT SOURCE DATA

Project A

Project A is a low frequency navigation system labeled the AN/ARN 131 Omega System. The specification used is model specification 33657-74-R-0673 dated 10 May 1974. It was revised on 30 July 1975.

Project B

Project B is a digital inertial measurement unit designated the AN/ARN 101(V). Its specification is CB 101-033-35351 dated 3 October 1975 and revised on 1 December 1976.

Project C

Project C is a two way radio operating in the 225 to 399.975 MegaHertz frequency range and it is designated the ARC 164(V). The specification is ENCA Exhibit 72-9 dated 28 November 1972 and revised 4 March 1974.

Project D

Project D is an interface electronics unit designed to interface with the LN-15 inertial measurement unit. Its specification is EC 229-10082-1 dated 22 December 1972 and revised 12 September 1974, 8 August, 1975

and 4 March 1977.

Project E

Project E is a terrain following radar unit data terminal. Its specification is EC 229-10059-1 dated 29 April 1974 and revised 24 September 1974, 8 August 1975, 24 September 1976 and 7 March 1977.

Project F

Project F is a defensive system electronics counter-measures receiver. Its specification is 00752-EC07878 139-0601 dated 5 June 1975 and revised 16 September 1975, 7 November 1975, 26 September 1976 and 1 March 1977.

Project G

Project G is an electronically steerable antenna system. Its original specification was ENADD Exhibit 76-21 dated 11 May 1977 and subsequently revised and superseded by specification 1708006 dated 5 December 1977 and itself revised on 2 January 1978.

APPENDIX FIVE
COMPUTER RUN WITH 23 RAW DATA POINTS

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

29 AUG 76 PAGE 2

FILE WARD (CREATION DATE = 29 AUG 76) WEAPON ACQUISITION REQUIREMENTS DATA

***** M U L T I P L E R E G R E S S I O N *****

VARIABLE	MEAN	STANDARD DEV	CASES
MISREQ	0.0035	2.6710	23
OPCHAR	115.6522	86.0125	23
DERSS	316.5652	163.1530	23
INTERFAC	60.3043	31.3114	23
TIME	13.0035	13.6664	23

CORRELATION COEFFICIENTS-

A VALUE OF 99.0000 IS PRINTED
IF A COEFFICIENT CANNOT BE COMPUTED.

OPCHAR	-.82326	.00954	.00001	.39799
DERSS	-.86743	.38396	.33821	
INTERFAC	-.44910	-.17663		
TIME	-.10000			
MISREQ		OPCHAR	DERSS	INTERFAC

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

24 AUG 78 PAGE 5

FILE WARD (CREATION DATE = 24 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** M U L T I P L E R E G R E S S I O N *****

DEPENDENT VARIABLE.. OPCHAR OPERATIONAL CHARACTERISTICS

MEAN RESPONSE 115.65217 STD. DEV. 66.81246

VARIABLE(S) ENTERED ON STEP NUMBER 1.. TIME TIME FROM SPEC START

MULTIPLE R	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
.17663	REGRESSION	1.	5077.55345	5077.55345	.67623	.42
R SQUARE	RESIDUAL	21.	157681.66394	7508.65066		
ADJUSTED R SQUARE	COEFF OF VARIABILITY	74.9 PCT				
STD DEVIATION						

----- VARIABLES IN THE EQUATION -----

----- VARIABLES NOT IN THE EQUATION -----

VARIABLE	B	STD ERROR B	T	BETA	SIGNIFICANCE	ELASTICITY	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFICANCE
TIME	-1.1116331	1.3516805	-.82233032	-.1766259	.420	-.12537					
(CONSTANT)	139.15174	25.246801	5.5153400	26.577539	.000						

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
TIME	-1.1116331	1.3516805	-.82233032	-3.9226720 ; 1.6996866
CONSTANT	139.15174	25.246801	5.5153400	77.6496884 ; 182.65367

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

TIME	1.02739
TIME	

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

24 AUG 78 PAGE 7

FILE WARD (CREATION DATE = 24 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE... DERSS DESIGN REQMT+SPEC STANDARDS

MEAN RESPONSE 316.56522 STD. DEV. 163.15290

VARIABLE(S) ENTERED ON STEP NUMBER 1... TIME TIME FROM SPEC START

MULTIPLE R	.33421	ANALYSIS OF VARIANCE	DF	SUM OF SQUARE	MEAN SQUARE	F	SIGNIFI
R SQUARE	.11170	REGRESSION	1	65012.59007	65012.59007	2.64063	.12
ADJUSTED R SQUARE	.06940	RESIDUAL	21	520203.06131	24771.57435		
STD DEVIATION	157.30900	COEFF OF VARIABILITY	49.7 PCT				

----- VARIABLES IN THE EQUATION -----

----- VARIABLES NOT IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	BETA	SIGNIFICANCE	ELASTICITY
----------	---	-------------	---	------	--------------	------------

VARIABLE	B	STD ERROR B	F	BETA	SIGNIFICANCE	ELASTICITY
----------	---	-------------	---	------	--------------	------------

TIME	3.9099266	2.4553366	2.6406312	.3342130	.11170	.16440
------	-----------	-----------	-----------	----------	--------	--------

(CONSTANT)	264.52270	45.055100	33.273370	.000		
------------	-----------	-----------	-----------	------	--	--

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
----------	---	-------------	---	------------------------------

TIME	3.9099266	2.4553366	1.6250019	-1.1162250 , 9.0908705
------	-----------	-----------	-----------	------------------------

CONSTANT	264.52270	45.055100	5.7606561	169.16162 , 359.08377
----------	-----------	-----------	-----------	-----------------------

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

TIME	6.02060
------	---------

TIME

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

24 AUG 78 PAGE 9

FILE MARD (CREATION DATE = 24 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

DEPENDENT VARIABLE.: INTERFAC INTERFACE REMOTS

MEAN RESPONSE 64.38435 STD. DEV. 31.31139

VARIABLE(S) ENTERED ON STEP NUMBER 1.: TIME TIME FROM SPEC START

MULTIPLE R	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNI
R SQUARE	REGRESSION	1.	3416.37385	3416.37385	3.95220	.06
ADJUSTED R SQUARE	RESIDUAL	21.	10152.49652	483.47460		
STD DEVIATION	COEFF OF VARIABILITY	45.7 PCT				

----- VARIABLES IN THE EQUATION -----

----- VARIABLES NOT IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	BETA	SIGNIFICANCE	ELASTICITY	VARIABLE	PARTIAL	TOLERANCE	SIGNIFICANCE
TIME	.91103629	.45066288	3.9522047	.3979871	.060	.10496				
(CONSTANT)	52.410831	0.5650842	37.437861	.880						

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
TIME	.91103629	.45066288	1.9980354	-.42083563E-01, 1.0656761
CONSTANT	52.410831	0.5650842	6.1105033	30.597103, 70.224479

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

TIME	TIME
.21037	

FILE HARD (CREATION DATE = 24 AUG 70) WEAPON ACQUISITION REQUIREMENTS DATA

DEPENDENT VARIABLE.. MISREQ MISSION REQUIREMENTS

MEAN RESPONSE 0.89346 STD. DEV. 2.67193

VARIABLE(S) ENTERED ON STEP NUMBER 1.. INTERFAC INTERFACE REQDMS

MULTIPLE R		ANALYSIS OF VARIANCE		DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIF
R SQUARE	.49918	REGRESSION	1.	39.89722	39.89722	5.61235	6.96629	.015
ADJUSTED R SQUARE	.31314	RESIDUAL	21.	117.85930				
STD DEVIATION	2.36989	COEFF OF VARIABILITY	29.5 PCT					

VARIABLES IN THE EQUATION

VARIABLE	B	STD ERROR B	F	BETA	SIGNIFICANCE	ELASTICITY	VARIABLE	PARTIAL	TOLERANCE	SIGNIFICANCE
INTERFAC	-.42579451E-01	.16138900E-01	6.9662965	-.4990931	.015	-.34037	DEPMAR	.15557	.98761	.49601440
(CONSTANT)	10.701265	1.1409036	60.858702				DEROS	.37250	.60250	3.2239284

VARIABLE(S) ENTERED ON STEP NUMBER 2.. DEROS DESIGN REQDMSPEC STANDARD8

MULTIPLE R		ANALYSIS OF VARIANCE		DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFIC
R SQUARE	.59492	REGRESSION	2.	55.45033	27.72916	5.46397	.013	
ADJUSTED R SQUARE	.35334	RESIDUAL	28.	101.49819	5.07491			
STD DEVIATION	2.25276	COEFF OF VARIABILITY	28.0 PCT					

VARIABLES IN THE EQUATION

VARIABLE	B	STD ERROR B	F	BETA	SIGNIFICANCE	ELASTICITY	VARIABLE	PARTIAL	TOLERANCE	SIGNIFICANCE
INTERFAC	-.56238592E-01	.17122901E-01	10.707336	-.6592626	.004	-.44964	UPCHAR	.22919	.00797	1.053573
DEROS	.59003374E-02	.32061296E-02	3.2239284	.3604072	.000	.23222				.318
(CONSTANT)	9.7928226	1.7235693	64.805361							

VARIABLES NOT IN THE EQUATION

FILE WARD (CREATION DATE = 24 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

DEPENDENT VARIABLE.. MISREQ MISSION REQUIREMENTS

VARIABLE(S) ENTERED ON STEP NUMBER 1.. OPCMAR OPERATIONAL CHARACTERISTICS

MULTIPLE R	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	.62234	3	60.78908	20.26327	4.00349	.022
ADJUSTED R SQUARE	.38730	19	96.16673	5.06141		
STD DEVIATION	.29056					
	2.24076					
	COEFF OF VARIABILITY	20.0 PCT				

VARIABLES IN THE EQUATION				VARIABLES NOT IN THE EQUATION			
VARIABLE	B	STD ERROR B	F	BET	ELASTICITY	VARIABLE	PARTIAL TOLERANCE
INTERFAC	-.6246903E-01	.10145963E-01	11.051727		-.7323090		
DERSS	.64012552E-02	.33170092E-02	3.7223001		-.49942		
OPCHAR	.60736766E-02	.59170479E-02	1.0533573		.25193		
(CONSTANT)	9.3317160	1.3016401	51.396775		.00733		

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
INTERFAC	-.6246903E-01	.10145963E-01	-3.4426337	-.10064944, -.24489967E-01
DERSS	.64012552E-02	.33170092E-02	1.9293380	-.54300311E-03, .13345593E-01
OPCHAR	.60736766E-02	.59170479E-02	1.0263320	-.63125215E-02, .10459075E-01
CONSTANT	9.3317160	1.3016401	7.1691544	6.6073353, 12.056097

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

OPCHAR	.00004	
DERSS	.00000	.00001
INTERFAC	-.00004	.00003

COMPUTER RUN WITH 23 TRANSFORMED DATA POINTS

APPENDIX SIX

APPENDIX SIX
COMPUTER RUN WITH 23 TRANSFORMED DATA POINTS

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

FILE WARD (CREATION DATE = 28 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

..... MULTIPLE REGRESSION

VARIABLE	MEAN	STANDARD DEV	CASES
MISREQ	104.0870	10.0087	23
UPCHAR	128.3678	42.5501	23
DENSS	140.0435	68.2605	23
INTERFAC	128.2174	33.0170	23
TIME	13.0435	13.6464	23

CORRELATION COEFFICIENTS.

A VALUE OF 99.0000 IS PRINTED
IF A COEFFICIENT CANNOT BE COMPUTED.

UPCHAR	.78996		
DENSS	.11334	.36464	
INTERFAC	.50680	.85118	.58529
TIME	.62738	.74290	.24143
			.65374
MISREQ	OPCHAR	DENSS	INTERFAC

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS
 FILE WARD CREATION DATE = 28 AUG 781 WEAPON ACQUISITION REQUIREMENTS DATA
 MULTIPLE REGRESSION
 DEPENDENT VARIABLE:.. MISREQ MISSION REQUIREMENTS
 MEAN RESPONSE 104.086% STD. DEV. 30.00869
 VARIABLE(S) ENTERED ON STEP NUMBER 1.. TIME TIME FROM SPEC START

MULTIPLE R .62738 ANALYSIS OF VARIANCE OF SUM OF SQUARES MEAN SQUARE F SIGNIFI-
 R SQUARE .39360 REGRESSION 1. 881.42599 881.42599 .001
 ADJUSTED R SQUARE .36674 RESIDUAL 21. 1336.48010 63.63810
 STD DEVIATION 7.97735 COEFF OF VARIABILITY 7.7 PCT

----- VARIABLES IN THE EQUATION -----
 VARIABLE B STD ERROR B F SIGNIFICANCE BETA ELASTICITY
 TIME .45944289 .1244491 13.63060 .001 .627375
 (CONSTANT) 94.091962 2.324187 1701.3207 .001 .05156

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
TIME	.45944289	.1244491	3.6919653	.20065418 ; .71823960
CONSTANT	94.091962	2.3241876	42.209790	93.260560 ; 102.92736

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

TIME .01549
 TIME

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

20 AUG 78 PAGE 5

FILE WARD (CREATION DATE = 20 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. OPLMAN OPERATIONAL CHARACTERISTICS

MEAN RESPONSE 128.14783 STD. DEV. 42.55009

VARIABLE(S) ENTERED ON STEP NUMBER 1.. TIME TIME FROM SPEC START

MULTIPLE R	.79290	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	.62869	REGRESSION	1.	25041.31018	25041.31018	35.55556	.0
ADJUSTED R SQUARE	.61100	RESIDUAL	21.	14789.90121	704.28010		
STD DEVIATION	26.53828	COEFF OF VARIABILITY	20.7 PCT				

----- VARIABLES IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	SIGNIFICANCE	BETA	ELASTICITY	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFICANCE
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TIME	2.4486887	.41400655	35.595859	.000	.7928970	.25088					
(CONSTANT)	96.187800	7.7318715	156.61559	.0							

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
TIME	2.4486887	.41400655	5.9428734	1.6076949 ; 3.3296424
CONSTANT	96.187800	7.7318715	12.435256	80.068493 ; 112.22711

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

TIME	.17140
CONSTANT	.17140

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS
 FILE WARD (CREATION DATE = 28 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA
 MULTIPLE REGRESSION
 DEPENDENT VARIABLE.. DEMSS DESIGN HEIGHTS SPEC STANDARDS

MEAN RESPONSE 140.04308 STD. DEV. 68.26092

VARIABLE(S) ENTERED ON STEP NUMBER 1.. TIME TIME FROM SPEC START

MULTIPLE R	.24143	ANALYSIS OF VARIANCE	OF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFIC
H SQUARE	.05929	REGRESSION	1.	5975.14089	5975.14089	1.29903	.27
ADJUSTED R SQUARE	.01345	RESIDUAL	21.	96533.81563	4596.84846		
STD DEVIATION	67.80000	COEFF OF VARIABILITY	48.4 PCT				

----- VARIABLES NOT IN THE EQUATION -----

VARIABLE	B	STD ERROR B	T	BETA	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFICANC
TIME	1.2050917	1.0577044	1.2990342	.2414311					
(CONSTANT)	124.31446	19.753394	39.605894	.11232					

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
TIME	1.2050917	1.0577044	1.1401027	-.99174506 : 3.4055084
CONSTANT	124.31446	19.753394	6.2933213	83.235074 : 165.39389

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

TIME	1.11874
TIME	

ANALYSIS OF WEAPON ACQUISITION REQUIREMENTS

DATE: 12/20/74 WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

INTERFAC INTERFAC REGRNTS

MEAN RESPONSE 128.2179 STD. DEV. 33.01784

VARIABLE(S) ENTERED ON STEP NUMBER 1.. TIME FROM SPEC START

MULTIPLE R	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
.65376	REGRESSION	1.	10260.11535	10260.11535	15.67119	.001
.42337	RESIDUAL	21.	13733.79770	653.99037		
.40011	COEFF OF VARIABILITY	19.9 PCT				
25.47324						

----- VARIABLES NOT IN THE EQUATION -----

VARIABLE	R	STD ERROR B	T	95.0 PCI CONFIDENCE INTERVAL	PARTIAL TOLERANCE	SIGNIFICANCE
TIME	1.5794235	.39805132	15.671190	.74975844		
(CONSTANT)	107.61621	7.4507041	208.82233	92.121627		

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	R	STD ERROR B	T	95.0 PCI CONFIDENCE INTERVAL
TIME	1.5794235	.39805132	15.671190	.74975844
CONSTANT	107.61621	7.4507041	208.82233	92.121627

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

TIME .15916

TIME

DEPENDENT VARIABLES •

MEAN RESPONSE	STD. DEV.
110.04646	10.00669

VARIABLE(S) ENTERED ON STEP NUMBER	100	OPC/MAR	OPERATIONAL CHARACTERISTICS
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MULTIPLE R		ANALYSIS OF VARIANCE		DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	.74990	REGRESSION	1	1375.28576	1375.28576	34.85769	0	
ADJUSTED R SQUARE	.62419	RESIDUAL	21	824.54033	39.26382			
STANDARD DEVIATION	0.28127	CORRECP UP VARIABILITY		6.0 PCT				

VARIABLES IN THE EQUATION				VARIABLES NOT IN THE EQUATION			
VARIABLE	B	STD ERROR B	F SIGNIFICANCE	BETA ELASTICITY	VARIABLE	PARTIAL TOLERANCE	F SIGNIFICANCE
PCMA9	.14541667	.31472800E-01	39.457689	.7899894	DERSS	.67269	.10607698
CONSTANT	40.237740	9.29449910	.000	.22911	INTERAC	.051450	.748
			357.02407				7.2023176
			0				.019

PARAMETER	UNIT	VALUE	DESCRIPTION
ANGLE(5)	DEGREE	90.	INTERFAC ANGLE
STEP NUMBER		20.	INTERFAC POINTS

ULTIMATE Q	ANALYSIS OF VARIANCE	OF	SUM OF SQUARES	MEAN SQUARE	SIGNIFIC
SQUARE	REGRESSION	%	1598.65716	797.22850	26.17759
ADJUSTED Q SQUARE	RESIDUAL	%	609.10892	30.95842	0
TOTAL DEVIATION	COEFF OF VARIABILITY	5.1 PER			

VARIABLES IN THE EQUATION						VARIABLES NOT IN THE EQUATION		
VARIABLE	B	STD ERROR B	F	PARTIAL TOLERANCE	F	SIGNIFICANCE		
DUMAY	.30616519	.02684670E-01	13.770435	1.301E-02				
MEDFAC	-.1922099H	.06744472E-01	7.2024176	.01753				
CONSTANT	AD.1538094	6.7500211H	383.52016	.019	.89747	6.4068306	.0020	

FILE WARD (COMPUTATION DATE = 28 AUG 78) STATION ACQUISITION REQUIREMENTS DATA

DEPENDENT VARIABLE.. M10M01 M10M02 M10M03 M10M04 M10M05 M10M06 M10M07 M10M08 M10M09 M10M10 M10M11 M10M12 M10M13 M10M14 M10M15 M10M16 M10M17 M10M18 M10M19 M10M20 M10M21 M10M22 M10M23 M10M24 M10M25 M10M26 M10M27 M10M28 M10M29 M10M30 M10M31 M10M32 M10M33 M10M34 M10M35 M10M36 M10M37 M10M38 M10M39 M10M40 M10M41 M10M42 M10M43 M10M44 M10M45 M10M46 M10M47 M10M48 M10M49 M10M50 M10M51 M10M52 M10M53 M10M54 M10M55 M10M56 M10M57 M10M58 M10M59 M10M60 M10M61 M10M62 M10M63 M10M64 M10M65 M10M66 M10M67 M10M68 M10M69 M10M70 M10M71 M10M72 M10M73 M10M74 M10M75 M10M76 M10M77 M10M78 M10M79 M10M80 M10M81 M10M82 M10M83 M10M84 M10M85 M10M86 M10M87 M10M88 M10M89 M10M90 M10M91 M10M92 M10M93 M10M94 M10M95 M10M96 M10M97 M10M98 M10M99 M10M100

VARIABLE(S) ENTERED ON STEP NUMBER 1.. DEMSS DESIGN REQUISITE SPEC STANDARDS

MULTIPLE R	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
0.9907	REGRESSION	3.	1700.27105	566.75702	24.30526	0
0.7912	RESIDUAL	19.	455.55503	23.97658		
0.7605	CORR OF VARIABILITY	9.7 PCT				

VARIABLES IN THE EQUATION				VARIABLES NOT IN THE EQUATION			
VARIABLE	B	STD ERROR B	F	ETA	VARIABLE	PARTIAL	TOLERANCE
			SIGNIFICANCE	ELASTICITY			SIGNIFICANCE
OPCHAP	.0000153	.0000000000	0.0000000000	0.0000000000			
INTERAC	.0000000000	.0000000000	0.0000000000	0.0000000000			
DEMSS	.0000000000	.0000000000	0.0000000000	0.0000000000			
(CONSTANT)	.0000000000	.0000000000	0.0000000000	0.0000000000			

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
OPCHAP	.0000153	.0000000000	0.0000000000	.0000000000
INTERAC	.0000000000	.0000000000	0.0000000000	.0000000000
DEMSS	.0000000000	.0000000000	0.0000000000	.0000000000
CONSTANT	.0000000000	.0000000000	0.0000000000	.0000000000

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

VARIABLE	OPCHAP	INTERAC	DEMSS
OPCHAP	.0000000000	.0000000000	.0000000000
INTERAC	.0000000000	.0000000000	.0000000000
DEMSS	.0000000000	.0000000000	.0000000000

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COMPUTER RUN WITH 64 TRANSFORMED DATA POINTS

APPENDIX SEVEN

VARIABLE	MEAN	STANDARD DEV	CASES
MISREQ	1.0225	.8760	64
OPCHAR	1.1600	.3052	64
DERSS	1.2516	.5084	64
INTERFAC	1.1691	.2350	64
TIME	14.1406	9.6377	64

CORRELATION COEFFICIENTS.

A VALUE OF 99.99999 IS PRINTED
 IF A COEFFICIENT CANNOT BE COMPUTED.

OPCHAR	.79928		
DERSS	.48676	.45852	
INTERFAC	.54741	.87447	.64120
TIME	.52085	.66998	.16147
			.52342
MISREQ		OPCHAR	DERSS
			INTERFAC

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

31 AUG 78 PAGE 3

FILE WARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. MISREQ MISSION REQUIREMENTS

MEAN RESPONSE 1.02250 STD. DEV. .07603

VARIABLE(S) ENTERED ON STEP NUMBER 1.. TIME TIME FROM SPEC START

MULTIPLE R	.52005	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	.27004	REGRESSION	1.	.10155	.10155	23.97250	O
ADJUSTED R SQUARE	.26721	RESIDUAL	62.	.26265	.00424		
STD DEVIATION	.06509	COEFF OF VARIABILITY	6.4 PCT				

----- VARIABLES IN THE EQUATION -----				----- VARIABLES NOT IN THE EQUATION -----			
VARIABLE	B	STD ERROR B	F	SIGNIFICANCE	BETA	ELASTICITY	PARTIAL TOLERANCE
TIME	.41650589E-02	.05003990E-03	23.972501		.5200522		
(CONSTANT)	.96359215	.14523901E-01	4401.6404		.05761		

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVAL.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
TIME	.41650589E-02	.05003990E-03	9.0961721	.24450541E-02, .5066630E-02
CONSTANT	.96359215	.14523901E-01	66.344905	.93455913, .99262510

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

TIME	.00000
TIME	

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

FILE HARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

MULTIPLE REGRESSION

DEPENDENT VARIABLE.. OPCMR OPERATIONAL CHARACTERISTICS

MEAN RESPONSE 1.16797 STD. DEV. .30521

VARIABLE(S) ENTERED ON STEP NUMBER 1... TIME TIME FROM SPEC START

MULTIPLE R .66998 ANALYSIS OF VARIANCE OF SUM OF SQUARES
R SQUARE .40888 REGRESSION 1. 2.63931
ADJUSTED R SQUARE .43999 RESIDUAL 62. 3.23433
STD DEVIATION .22000 COEFF OF VARIABILITY 19.6 PCT

MEAN SQUARE 50.49885
2.63931
.05217

VARIABLE PARTIAL TOLERANCE F SIGNIFICANCE

TIME .21217347E-01 .29057524E-02 50.49889 .6699846
(CONSTANT) .06794220 .50967294E-01 290.00031 .25608

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE B STD ERROR B T 95.0 PCT CONFIDENCE INTERVAL
TIME .21217347E-01 .29057524E-02 7.1061900 .15240913E-01, .27105701E-01
CONSTANT .06794220 .50967294E-01 17.029395 .16606003, .96942437

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

TIME .00001
TIME

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

FILE HAND (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. DLRSS DESIGN REQMT+SPEC STANDARDS

MEAN RESPONSE 1.25156 STD. DEV. .38848

VARIABLE(S) ENTERED ON STEP NUMBER 1.. TIME TIME FROM SPEC START

MULTIPLE R	.6187	ANALYSIS OF VARIANCE	OF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	.02407	REGRESSION	1.	.56100	.56100	1.65986	.20
ADJUSTED R SQUARE	.01817	RESIDUAL	62.	20.95484	.33796		
STD DEVIATION	.58136	COEFF OF VARIABILITY	46.5 PCT				

----- VARIABLES IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFICANCE
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TIME	.97912745E-02	.7590333E-02	1.6598557	.1614739					
(CONSTANT)	1.1131078	.12973043	73.616136	.11063					
			.000						

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
TIME	.97912745E-02	.7590333E-02	1.2803539	-.54085758E-02, .24983125E-01
CONSTANT	1.1131078	.12973043	8.5901594	.06370033, 1.3724352

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

TIME	.08886
TIME	

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

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FILE HARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. INTERFAC INTERFACE REQUIS

MEAN RESPONSE 1.1696 STD. DEV. .25584

VARIABLE(S) ENTERED ON STEP NUMBER 1.. TIME TIME FROM SPEC START

MULTIPLE R	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	.52362	REGRESSION	1.	1.12976	1.12976	0
ADJUSTED R SQUARE	.26225	RESIDUAL	62.	2.93398	.48029	
STD DEVIATION	.21975	COEFF OF VARIABILITY	18.8 PCT			

----- VARIABLES IN THE EQUATION -----				----- VARIABLES NOT IN THE EQUATION -----				
VARIABLE	B	STD ERROR B	T	SIGNIFICANCE	BETA	VARIABLE	PARTIAL TOLERANCE	F SIGNIFICANCE
TIME	.13094759E-01	.20726759E-02	23.395323		.5239166			
(CONSTANT)	.97258193	.49837004E-01	393.37235		.16887			

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
TIME	.13094759E-01	.20726759E-02	4.0160712	.01521613E-02, .19637154E-01
CONSTANT	.97258193	.49837004E-01	19.033617	.07455827, 1.0706056

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

TIME	.00001
TIME	

DEPENDENT VARIABLE.. MISREQ MISSION REQUIREMENTS

MEAN RESPONSE 1.2250 STD. DEV. .07603

VARIABLE(S) ENTERED ON STEP NUMBER 1.. OPCHAR OPERATIONAL CHARACTERISTICS

MULTIPLE R	.79920	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFIC
R SQUARE	.63805	REGRESSION	1.	.23267	.23267	109.67302	O
ADJUSTED R SQUARE	.63303	RESIDUAL	62.	.11353	.00212		
STD DEVIATION	.06606	COEFF OF VARIABILITY	4.5 PCT				

----- VARIABLES IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL	TOLERANCE	F
OPCHAR	.19911356	.19812943E-01	109.67302	.7992009	DEHSS	.00122	.79341	.40502072
(CONSTANT)	.70994150	.22940740E-01	1105.1000	.22744	INTERFAC	-.51903	.23531	22.507501
			.000					.000

VARIABLE(S) ENTERED ON STEP NUMBER 2.. INTERFAC INTERFACE REUNTS

MULTIPLE R	.05016	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFIC
R SQUARE	.73644	REGRESSION	2.	.26821	.13411	05.22419	O
ADJUSTED R SQUARE	.72700	RESIDUAL	61.	.09599	.00157		
STD DEVIATION	.03907	COEFF OF VARIABILITY	3.9 PCT				

----- VARIABLES IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL	TOLERANCE	F
OPCHAR	.33940651	.33756491E-01	101.09400	1.3624444	DEHSS	.53107	.54070	23.570027
INTERFAC	-.19113009	.40269053E-01	22.507501	.30769				.000
(CONSTANT)	.06902044	.23033707E-01	1315.1650	-.21002				

FILE WAND (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. MISREQ MISSION REQUIREMENTS

VARIABLE(S) ENTERED ON STEP NUMBER 3.. DERSS DESIGN REQMT+SPEC STANDARDS

MULTIPLE R	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	REGRESSION	3	.29528	.09843		
ADJUSTED R SQUARE	RESIDUAL	68	.00092	.00115		
STD DEVIATION	COEFF OF VARIABILITY	3.3 PCT				

VARIABLES IN THE EQUATION				VARIABLES NOT IN THE EQUATION			
VARIABLE	B	STD ERROR B	F SIGNIFICANCE	BETA ELASTICITY	VARIABLE	PARTIAL TOLERANCE	F SIGNIFICANCE
OPCHAR	.38111419	.38892436E-01	160.39674	1.5288672			
INTERFAC	-.30555444	.41673521E-01	53.759694	-.43533			
DERSS	.48236354E-01	.99356876E-02	23.578827	.3787522			
(CONSTANT)	.07421196	.28641126E-01	1793.7699	.05904			

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
OPCHAR	.38111419	.38892436E-01	12.644784	.32092036 , .44130803
INTERFAC	-.30555444	.41673521E-01	-7.3321803	-.38891389 , -.22219498
DERSS	.48236354E-01	.99356876E-02	4.8548973	.20362179E-01 , .68110528E-01
CONSTANT	.07421196	.28641126E-01	42.352921	.03292356 , .91550835

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

OPCHAR	.000091	
DERSS	.000049	.000144
INTERFAC	-.00107	-.00023

OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SD	P.0
1.	1.000000	.9980001	.1991935E-02		1.
2.	1.000000	.9980001	.1991935E-02		1.
3.	1.000000	.9980001	.1991935E-02		1.
4.	1.000000	.9980001	.1991935E-02		1.
5.	1.000000	.9980001	.1991935E-02		1.
6.	1.000000	.9980001	.1991935E-02		1.
7.	1.000000	.9980001	.1991935E-02		1.
8.	1.000000	.9980001	.1991935E-02		1.
9.	1.000000	.9980001	.1991935E-02		1.
10.	1.000000	.9980001	.1991935E-02		1.
11.	1.000000	.9980001	.1991935E-02		1.
12.	1.000000	.9980001	.1991935E-02		1.
13.	1.000000	.9980001	.1991935E-02		1.
14.	1.000000	.9980001	.1991935E-02		1.
15.	1.000000	.9980001	.1991935E-02		1.
16.	1.000000	.9980001	.1991935E-02		1.
17.	1.000000	.9980001	.1991935E-02		1.
18.	1.000000	.9980001	.1991935E-02		1.
19.	1.000000	.9980001	.1991935E-02		1.
20.	1.000000	.9980001	.1991935E-02		1.
21.	1.000000	.9980001	.1991935E-02		1.
22.	1.000000	.9980001	.1991935E-02		1.
23.	1.000000	.9980001	.1991935E-02		1.
24.	1.000000	.9980001	.1991935E-02		1.
25.	1.000000	.9980001	.1991935E-02		1.
26.	1.000000	.9980001	.1991935E-02		1.
27.	1.000000	.9980001	.1991935E-02		1.
28.	1.000000	.9980001	.1991935E-02		1.
29.	1.000000	.9980001	.1991935E-02		1.
30.	1.000000	.9980001	.1991935E-02		1.
31.	1.000000	.9980001	.1991935E-02		1.
32.	1.000000	.9980001	.1991935E-02		1.
33.	1.000000	.9980001	.1991935E-02		1.
34.	1.000000	.9980001	.1991935E-02		1.
35.	1.000000	.9980001	.1991935E-02		1.
36.	1.000000	.9980001	.1991935E-02		1.
37.	1.000000	.9980001	.1991935E-02		1.
38.	1.000000	.9980001	.1991935E-02		1.
39.	1.000000	.9980001	.1991935E-02		1.
40.	1.000000	.9980001	.1991935E-02		1.
41.	1.000000	.9980001	.1991935E-02		1.
42.	1.000000	.9980001	.1991935E-02		1.
43.	1.000000	.9980001	.1991935E-02		1.
44.	1.000000	.9980001	.1991935E-02		1.
45.	1.000000	.9980001	.1991935E-02		1.
46.	1.000000	.9980001	.1991935E-02		1.
47.	1.000000	.9980001	.1991935E-02		1.
48.	1.000000	.9980001	.1991935E-02		1.
49.	1.000000	.9980001	.1991935E-02		1.
50.	1.000000	.9980001	.1991935E-02		1.
51.	1.000000	.9980001	.1991935E-02		1.

R

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

WEAPON ACQUISITION REQUIREMENTS DATA

FILE NAME (CREATION DATE = 31 AUG 70) MULTIPLE REGRESSION

OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SD	0.0	R
533	1.00000	1.00000	-.00000			
544	1.00000	1.00000	-.00000			
551	1.00000	1.00000	-.00000			
560	1.00000	1.00000	-.00000			
570	1.00000	1.00000	-.00000			
580	1.00000	1.00000	-.00000			
590	1.00000	1.00000	-.00000			
600	1.00000	1.00000	-.00000			
610	1.00000	1.00000	-.00000			
620	1.00000	1.00000	-.00000			
630	1.00000	1.00000	-.00000			
640	1.00000	1.00000	-.00000			

NOTE - (a) INDICATES ESTIMATE CALCULATED WITH MEANS SUBSTITUTED
R INDICATES POINT OUT OF RANGE OF PLOT

NUMBER OF CASES PLUTIED	62	OR	7.01 PERCENT OF THE TOTAL
NUMBER OF 2 S.D. OUTLIERS			
VON NEUMANN RATIO	2.27191		DURBIN-WATSON TEST 2.23592
NUMBER OF POSITIVE RESIDUALS	24		
NUMBER OF NEGATIVE RESIDUALS	24		
NUMBER OF RUNS OF SIGNS			
EXPECTED NUMBER OF RUNS OF SIGNS	31		
EXPECTED S.D. OF RUN DISTRIBUTION	3.71612		
UNIT NORMAL DEViate	-1.74914		
Z=(EXPECTED-OBSERVED)/S.D.	.00013		
PROBABILITY OF OBTAINING .GE. ABS(2)			

DEPENDENT VARIABLE... OPERCHAR OPERATIONAL CHARACTERISTICS

MEAN RESPONSE 1.16797 STD. DEV. .30521

VARIABLE(S) ENTERED ON STEP NUMBER 1.. INTERFAC INTERFACE HEIGHTS

MULTIPLE R	.67447	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	.76469	REGRESSION	1,	4.48771	4.48771	281.40607	O
ADJUSTED R SQUARE	.76090	RESIDUAL	62,	1.30893	.02227		
STD DEVIATION	.10924	COEFF OF VARIABILITY	12.6 PCT				

VARIABLES IN THE EQUATION				VARIABLES NOT IN THE EQUATION			
VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL TOLERANCE	F
INTERFAC	1.0431972	.73492652E-01	281.40607	.0744675	MISREQ	.70035	101.09400
(CONSTANT)	-.51594031E-01	.07919473E-01	.34437274	1.04417	DEKSS	.50876	5.4126261
			.559				.023

VARIABLE(S) ENTERED ON STEP NUMBER 2.. MISREQ MISSION REQUIREMENTS

MULTIPLE R	.95470	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	.91145	REGRESSION	2,	5.34896	2.67448	311.93172	O
ADJUSTED R SQUARE	.90855	RESIDUAL	61,	.51968	.00852		
STD DEVIATION	.09230	COEFF OF VARIABILITY	7.9 PCT				

VARIABLES IN THE EQUATION				VARIABLES NOT IN THE EQUATION			
VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL TOLERANCE	F
INTERFAC	.74426541	.54312405E-01	107.78302	.6230058	DEKSS	.57927	30.300109
MISREQ	1.0375468	.10275764	101.09400	.74896		.50433	.000
(CONSTANT)	-1.5010156	.16153075	95.709716	.4577621			
				1.60060			

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AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH
A STUDY OF RESEARCH AND DEVELOPMENT CONTRACT REQUIREMENTS AND T--ETC(U)
MAY 79 R 6 BLACKLEDGE
AFIT-CI-79-2140

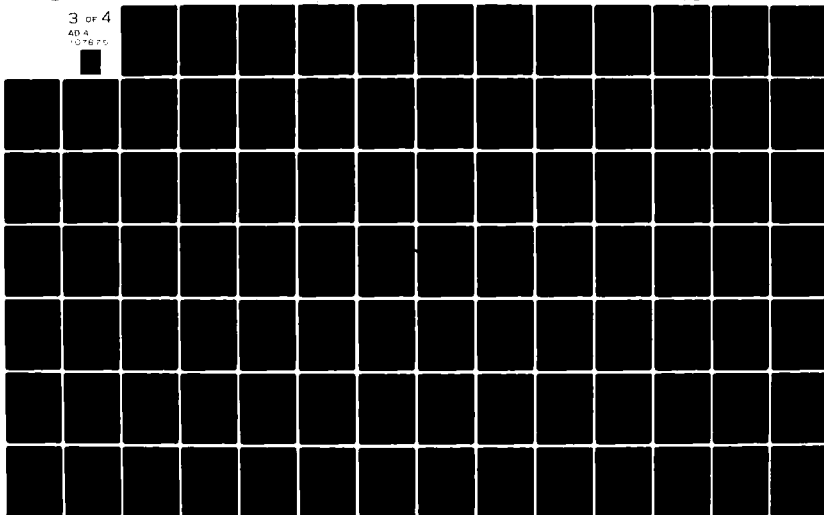
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FILE HARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION MEASUREMENTS DATA
 ***** MULTIPLE REGRESSION *****
 DEPENDENT VARIABLE.. UPCHAN OPERATIONAL CHARACTERISTICS
 VARIABLE(S) ENTERED ON STEP NUMBER 3.. DERSS DESIGN REUMTASPEC STANDARDS

MULTIPLE R	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	REGRESSION	3.	5.52334	1.84111	319.91529	O
ADJUSTED R SQUARE	RESIDUAL	68.	.34330	.00505		
STD DEVIATION	COEFF OF VARIABILITY	6.5 PCT				

----- VARIABLES IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFICANC
INTERFAC	.90506076	.53347052E-01	207.02041	.7506736					
MISREU	1.9095605	.15077703	160.39678	.90591					
DERSS	-.11777093	.21395155E-01	30.300109	.167173					
(CONSTANT)	-1.6952400	.13430101	159.14264	-.12620					

----- VARIABLES NOT IN THE EQUATION -----

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
INTERFAC	.90506076	.53347052E-01	16.965271	.7903091
MISREU	1.9095605	.15077703	12.664704	1.607060
DERSS	-.11777093	.21395155E-01	-5.504500	-1.6056161
CONSTANT	-1.6952400	.13430101	-12.615175	-1.9600420

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

	MISREU	DERSS	INTERFAC
MISREU	.42273		
DERSS	-.00020	.00006	
INTERFAC	-.00129	-.00062	.00205

OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SU	W
14	1.000000	1.001618	-.1618373E-02		.1
24	1.000000	1.001618	-.1618373E-02		.1
34	1.000000	1.001618	-.1618373E-02		.1
44	1.000000	1.001618	-.1618373E-02		.1
54	1.000000	1.001618	-.1618373E-02		.1
64	1.000000	1.001618	-.1618373E-02		.1
74	1.000000	1.001618	-.1618373E-02		.1
84	1.000000	1.001618	-.1618373E-02		.1
94	1.000000	1.001618	-.1618373E-02		.1
104	1.000000	1.001618	-.1618373E-02		.1
114	1.000000	1.001618	-.1618373E-02		.1
124	1.000000	1.001618	-.1618373E-02		.1
134	1.000000	1.001618	-.1618373E-02		.1
144	1.000000	1.001618	-.1618373E-02		.1
154	1.000000	1.001618	-.1618373E-02		.1
164	1.000000	1.001618	-.1618373E-02		.1
174	1.000000	1.001618	-.1618373E-02		.1
184	1.000000	1.001618	-.1618373E-02		.1
194	1.000000	1.001618	-.1618373E-02		.1
204	1.000000	1.001618	-.1618373E-02		.1
214	1.000000	1.001618	-.1618373E-02		.1
224	1.000000	1.001618	-.1618373E-02		.1
234	1.000000	1.001618	-.1618373E-02		.1
244	1.000000	1.001618	-.1618373E-02		.1
254	1.000000	1.001618	-.1618373E-02		.1
264	1.000000	1.001618	-.1618373E-02		.1
274	1.000000	1.001618	-.1618373E-02		.1
284	1.000000	1.001618	-.1618373E-02		.1
294	1.000000	1.001618	-.1618373E-02		.1
304	1.000000	1.001618	-.1618373E-02		.1
314	1.000000	1.001618	-.1618373E-02		.1
324	1.000000	1.001618	-.1618373E-02		.1
334	1.000000	1.001618	-.1618373E-02		.1
344	1.000000	1.001618	-.1618373E-02		.1
354	1.000000	1.001618	-.1618373E-02		.1
364	1.000000	1.001618	-.1618373E-02		.1
374	1.000000	1.001618	-.1618373E-02		.1
384	1.000000	1.001618	-.1618373E-02		.1
394	1.000000	1.001618	-.1618373E-02		.1
404	1.000000	1.001618	-.1618373E-02		.1
414	1.000000	1.001618	-.1618373E-02		.1
424	1.000000	1.001618	-.1618373E-02		.1
434	1.000000	1.001618	-.1618373E-02		.1
444	1.000000	1.001618	-.1618373E-02		.1
454	1.000000	1.001618	-.1618373E-02		.1
464	1.000000	1.001618	-.1618373E-02		.1
474	1.000000	1.001618	-.1618373E-02		.1
484	1.000000	1.001618	-.1618373E-02		.1
494	1.000000	1.001618	-.1618373E-02		.1
504	1.000000	1.001618	-.1618373E-02		.1
514	1.000000	1.001618	-.1618373E-02		.1

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

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FILE WARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SD	0.0
53:	1.13000	1.026050	.1031496		1
54:	1.45000	1.470024	-.0202357E-01		1
55:	1.97000	1.064000	.1059605		1
56:	1.19000	1.230919	.0891052E-01		1
57:	1.13000	1.026050	.1031496		1
58:	1.19000	1.100404	.0595076E-02		1
59:	1.19000	1.230919	.0891052E-01		1
60:	1.93000	2.050397	-.1203960		1
61:	1.90000	1.100404	.0595076E-02		1
62:	1.21000	1.147164	.0263625E-01		1
63:	1.93000	2.050397	-.1203960		1
64:	2.75000	2.400700	.3412915		1

NOTE - (A) INDICATES ESTIMATE CALCULATED WITH MEANS SUBSTITUTED
R INDICATES POINT OUT OF RANGE OF PLOT

NUMBER OF CASES PLOTTED 64.
NUMBER OF 2 S.D. OUTLIERS 3, OR 4.69 PERCENT OF THE TOTAL

VON NEUMANN RATIO 2.10512 DURBIN-WATSON TEST 2.07223

NUMBER OF POSITIVE RESIDUALS 24.
NUMBER OF NEGATIVE RESIDUALS 40.
NUMBER OF RUNS OF SIGNS 26.

EXPECTED NUMBER OF RUNS OF SIGNS 31.
EXPECTED S.D. OF RUN DISTRIBUTION 3.71612
UNIT NORMAL DEViate- -1.21094
2-(EXPECTED-OBSERVED)/S.D. .11296
PROBABILITY OF OBTAINING .GE. .000(2)

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. DLRS5 DESIGN HEIGHT+SPEC STANDARDS

MEAN RESPONSE 1.25156 STD. DEV. .50440

VARIABLE(S) ENTERED ON STEP NUMBER 1.. INTERFAC INTERFACE HEIGHTS

MULTIPLE R	.64120	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	.41124	REGRESSION	1.	8.44816	8.44816	43.30598	0
ADJUSTED R SQUARE	.40174	RESIDUAL	62.	12.66768	.20432		
STD DEVIATION	.45201	COEFF OF VARIABILITY	36.1 PCT				

----- VARIABLES IN THE EQUATION -----				----- VARIABLES NOT IN THE EQUATION -----			
VARIABLE	B	STD ERROR B	F	DELTA	VARIABLE	PARTIAL TOLERANCE	F
INTERFAC	1.4640802	.22259861	43.305978	.6412796	MISREQ	.00678	.78835
(CONSTANT)	-.46888986	.26620579	2.9937808	1.36825	OPCHAR	-.20540	.23531
			.888				.46282768
			.888				.499
			.888				5.4126261
			.888				.023

***** OPERATIONAL CHARACTERISTICS *****

MULTIPLE R	.67766	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	.45922	REGRESSION	2.	9.88858	4.94429	25.98838	0
ADJUSTED R SQUARE	.44149	RESIDUAL	61.	11.63526	.19074		
STD DEVIATION	.43674	COEFF OF VARIABILITY	34.9 PCT				

----- VARIABLES IN THE EQUATION -----				----- VARIABLES NOT IN THE EQUATION -----			
VARIABLE	B	STD ERROR B	F	DELTA	VARIABLE	PARTIAL TOLERANCE	F
INTERFAC	2.3668113	.44336392	28.497449	1.0361683	MISREQ	.53107	.26356
OPCHAR	-.86465252	.37165296	5.4126261	2.21888			23.578827
(CONSTANT)	-.54554477	.25888895	3.6384491	-.88698			.008
			.023				
			.888				

FILE WARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. DERSS DESIGN REQNT+SPEC STANDARDS

VARIABLE(S) ENTERED ON STEP NUMBER 3.. MISREQ MISSION REQUIREMENTS

MULTIPLE R	.70214	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	.61174	REGRESSION	3.	13.16218	4.38739	31.51236	O
ADJUSTED R SQUARE	.59233	RESIDUAL	60.	0.35366	.13923		
STD DEVIATION	.37313	COEFF OF VARIABILITY	29.0 PCT				

----- VARIABLES IN THE EQUATION -----				----- VARIABLES NOT IN THE EQUATION -----			
VARIABLE	B	STD ERROR B	F SIGNIFICANCE	BETA ELASTICITY	VARIABLE	PARTIAL TOLERANCE	* SIGNIFICANCE

INTERFAC	3.4050626	.44341040	61.002060	1.5260706			
OPCHAR	-2.0491714	.51760195	30.308189	-1.4880173			
MISREQ	5.0470266	1.2043564	23.578027	-2.65807			
(CONSTANT)	-5.4744703	1.0469032	27.301439	4.77690			

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
INTERFAC	3.4050626	.44341040	7.6614000	2.5009096 , 4.3720156
OPCHAR	-2.0491714	.51760195	-5.5045600	-3.0845295 , -1.0130133
MISREQ	5.0470266	1.2043564	4.1840973	3.4379551 , 6.2560901
CONSTANT	-5.4744703	1.0469032	-5.2289042	-7.5607005 , -3.3802321

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

MISREQ	1.45347	
OPCHAR	-.49230	-.26791
INTERFAC	.27760	-.19940

OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SD	9.9
1.	1.888888	1.889240	-.0247516E-02		1
2.	1.000000	1.009240	-.9247516E-02		1
3.	1.000000	1.009240	-.9247516E-02		1
4.	1.000000	1.009240	-.9247516E-02		1
5.	1.000000	1.009240	-.9247516E-02		1
6.	1.000000	1.009240	-.9247516E-02		1
7.	1.000000	1.009240	-.9247516E-02		1
8.	1.070000	1.001002	-.2691792E-01		1
9.	1.000000	1.009240	-.9247516E-02		1
10.	1.000000	1.009240	-.9247516E-02		1
11.	1.000000	1.009240	-.9247516E-02		1
12.	1.000000	1.009240	-.9247516E-02		1
13.	1.000000	1.009240	-.9247516E-02		1
14.	1.000000	1.009240	-.9247516E-02		1
15.	1.320000	1.371205	-.5120516E-01		1
16.	1.060000	1.020340	-.3165175E-01		1
17.	1.000000	1.009240	-.9247516E-02		1
18.	1.000000	1.009240	-.9247516E-02		1
19.	1.000000	1.009240	-.9247516E-02		1
20.	1.000000	1.009240	-.9247516E-02		1
21.	1.000000	1.009240	-.9247516E-02		1
22.	1.010000	1.090901	-.0898092E-01		1
23.	1.200000	1.371205	-.5120516E-01		1
24.	1.000000	1.020340	-.3165175E-01		1
25.	1.000000	1.009240	-.9247516E-02		1
26.	1.000000	1.009240	-.9247516E-02		1
27.	1.000000	1.009240	-.9247516E-02		1
28.	1.000000	1.009240	-.9247516E-02		1
29.	4.280000	2.749601	1.490399		1
30.	1.320000	1.371205	-.5120516E-01		1
31.	1.060000	1.020340	-.3165175E-01		1
32.	1.000000	1.009240	-.9247516E-02		1
33.	1.000000	1.009240	-.9247516E-02		1
34.	1.000000	1.009240	-.9247516E-02		1
35.	1.000000	2.461173	-.0011733		1
36.	1.000000	1.009240	-.9247516E-02		1
37.	1.000000	1.009240	-.9247516E-02		1
38.	1.060000	1.020340	-.3165175E-01		1
39.	1.320000	1.371205	-.5120516E-01		1
40.	4.280000	2.749601	1.490399		1
41.	1.760000	2.560000	-.0000001		1
42.	1.000000	1.020340	-.7165175E-01		1
43.	1.060000	1.020340	-.3165175E-01		1
44.	1.320000	1.371205	-.5120516E-01		1
45.	1.000000	1.009240	-.9247516E-02		1
46.	1.170000	.6131404	.3560516		1
47.	1.320000	1.371205	-.5120516E-01		1
48.	1.000000	1.009240	-.9247516E-02		1
49.	1.000000	1.740921	-.2609207		1
50.	1.170000	.6131404	.3560516		1

R

R

R

R

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

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FILE WARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SD	9.8
534	1.17000	.8131484	.3568516		1
54	1.40000	1.748921	-.2689207		1
55	1.90000	1.975424	-.7542423E-01		1
56	1.06000	1.409000	-.3490076		1
57	1.17000	.8131484	.3568516		1
58	1.40000	1.374229	.1957760		1
59	1.06000	1.409000	-.3490076		1
60	1.22000	2.031968	-.8119682	R	1
61	1.40000	1.374229	.1957760		1
62	1.53000	1.212670	.3173301		1
63	1.22000	2.031968	-.8119682	R	1
64	1.55000	1.194569	.3554314		1

NOTE - (-) INDICATES ESTIMATE CALCULATED WITH MEANS SUBSTITUTED
 R INDICATES POINT OUT OF RANGE OF PLOT

NUMBER OF CASES PLOTTED	64	9.38 PERCENT OF THE TOTAL
NUMBER OF 2 S.D. OUTLIERS	6	
VON NEUMANN RATIO	2.53410	DURRIN-WATSON TEST 2.49951
NUMBER OF POSITIVE RESIDUALS	17	
NUMBER OF NEGATIVE RESIDUALS	47	
NUMBER OF RUNS OF SIGNS	26	
EXPECTED NUMBER OF RUNS OF SIGNS	26	
EXPECTED S.D. OF RUN DISTRIBUTION	3.06213	
UNIT NORMAL DEViate		
Z=(EXPECTED-OBSERVED)/S.D.	.02127	
PROBABILITY OF OBTAINING .GE. ABS(Z)	.20575	

DEPENDENT VARIABLE.. INTERFAC INTERFACE REUNTS

MEAN RESPONSE 1.169M6 STD. DEV. .25504

VARIABLE(S) ENTERED ON STEP NUMBER 1.. OPCNAR OPERATIONAL CHARACTERISTICS

MULTIPLE R	ANALYSIS OF VARIANCE	OF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFIC
R SQUARE	.07447	1.	3.15340	3.15340	281.40607	0
ADJUSTED R SQUARE	.76669	62.	.97034	.01565		
STD DEVIATION	.12510	COEFF OF VARIABILITY	10.7 PCT			

----- VARIABLES NOT IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	BETA	PARTIAL	TOLERANCE	F	SIGNIFICANC
OPNAR	.73302862	.51001409E-01	281.40607	.0744673	.56020	.79341	28.497409	
(CONSTANT)	.31290797	.62309021E-01	25.210550	.73234	-.51903	.36115	22.507501	

----- VARIABLES IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	BETA	PARTIAL	TOLERANCE	F	SIGNIFICANC
OPNAR	.73302862	.51001409E-01	281.40607	.0744673	.56020	.79341	28.497409	
(CONSTANT)	.31290797	.62309021E-01	25.210550	.73234	-.51903	.36115	22.507501	

----- VARIABLES NOT IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	BETA	PARTIAL	TOLERANCE	F	SIGNIFICANC
OPNAR	.73302862	.51001409E-01	281.40607	.0744673	.56020	.79341	28.497409	
(CONSTANT)	.31290797	.62309021E-01	25.210550	.73234	-.51903	.36115	22.507501	

----- VARIABLES NOT IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	BETA	PARTIAL	TOLERANCE	F	SIGNIFICANC
OPNAR	.61594529	.40254677E-01	162.93165	.7347920	-.60744	.35077	53.759694	
DERSS	.13453401	.25201040E-01	20.497409	.61537				
(CONSTANT)	.20127992	.52199040E-01	29.037037	.3073021				

DEPENDENT VARIABLE.. INTERFAC INTERFACE REMDIS

VARIABLE(S) ENTERED ON STEP NUMBER 3.. MISREQ MISSION REQUIREMENTS

MULTIPLE R	.95677	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFIC
R SQUARE	.91541	REGRESSION	3.	3.77492	1.25831	216.43630	O
ADJUSTED R SQUARE	.91110	RESIDUAL	60.	.34882	.00581		
STD DEVIATION	.07625	COEFF OF VARIABILITY	6.5 PCT				

----- VARIABLES IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFICANC
			SIGNIFICANCE	ELASTICITY					
OPCHAR	.91430015	.51092450E-01	207.02041	1.0907156					
DERSS	.14555960	.10515597E-01	61.002064	.91394					
MISREQ	-1.5466063	.21093633	53.759694	.15503					
(CONSTANT)	1.5000165	.17061002	77.341136	-1.35271					

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
OPCHAR	.91430015	.51092450E-01	16.965271	.08649910 , 1.0221011
DERSS	.14555960	.10515597E-01	7.0614000	.0052299 , .10259621
MISREQ	-1.5466063	.21093633	-7.3321003	-1.9685410 , -1.1246700
CONSTANT	1.5000165	.17061002	8.7993009	1.1591449 , 1.8416090

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

DERSS	.00014	
MISREQ	-.00032	.00009
OPCHAR	-.00024	-.00050
DERSS		
MISREQ		
OPCHAR		

OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SD	0.0
1.	1.000000	1.013670	-.1366995E-01		1
2.	1.000000	1.013670	-.1366995E-01		1
3.	1.000000	1.013670	-.1366995E-01		1
4.	1.000000	1.013670	-.1366995E-01		1
5.	1.000000	1.013670	-.1366995E-01		1
6.	1.000000	1.013670	-.1366995E-01		1
7.	1.000000	1.013670	-.1366995E-01		1
8.	1.000000	1.013670	-.1366995E-01		1
9.	1.000000	1.013670	-.1366995E-01		1
10.	1.000000	1.013670	-.1366995E-01		1
11.	1.000000	1.013670	-.1366995E-01		1
12.	1.000000	1.013670	-.1366995E-01		1
13.	1.000000	1.013670	-.1366995E-01		1
14.	1.000000	1.013670	-.1366995E-01		1
15.	1.000000	1.013670	-.1366995E-01		1
16.	1.000000	1.013670	-.1366995E-01		1
17.	1.000000	1.013670	-.1366995E-01		1
18.	1.000000	1.013670	-.1366995E-01		1
19.	1.000000	1.013670	-.1366995E-01		1
20.	1.000000	1.013670	-.1366995E-01		1
21.	1.000000	1.013670	-.1366995E-01		1
22.	1.000000	1.013670	-.1366995E-01		1
23.	1.000000	1.013670	-.1366995E-01		1
24.	1.000000	1.013670	-.1366995E-01		1
25.	1.000000	1.013670	-.1366995E-01		1
26.	1.000000	1.013670	-.1366995E-01		1
27.	1.000000	1.013670	-.1366995E-01		1
28.	1.000000	1.013670	-.1366995E-01		1
29.	1.000000	1.013670	-.1366995E-01		1
30.	1.000000	1.013670	-.1366995E-01		1
31.	1.000000	1.013670	-.1366995E-01		1
32.	1.000000	1.013670	-.1366995E-01		1
33.	1.000000	1.013670	-.1366995E-01		1
34.	1.000000	1.013670	-.1366995E-01		1
35.	1.000000	1.013670	-.1366995E-01		1
36.	1.000000	1.013670	-.1366995E-01		1
37.	1.000000	1.013670	-.1366995E-01		1
38.	1.000000	1.013670	-.1366995E-01		1
39.	1.000000	1.013670	-.1366995E-01		1
40.	1.000000	1.013670	-.1366995E-01		1
41.	1.000000	1.013670	-.1366995E-01		1
42.	1.000000	1.013670	-.1366995E-01		1
43.	1.000000	1.013670	-.1366995E-01		1
44.	1.000000	1.013670	-.1366995E-01		1
45.	1.000000	1.013670	-.1366995E-01		1
46.	1.000000	1.013670	-.1366995E-01		1
47.	1.000000	1.013670	-.1366995E-01		1
48.	1.000000	1.013670	-.1366995E-01		1
49.	1.000000	1.013670	-.1366995E-01		1
50.	1.000000	1.013670	-.1366995E-01		1

R

R

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MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

FILE WARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SD	0.8
53	1.450000	1.157274	-.102726		1
54	1.500000	1.494974	-.005026		1
55	2.070000	2.011545	-.041545		1
56	1.270000	1.196121	-.076121		1
57	1.450000	1.157274	-.102726		1
58	1.260000	1.257256	-.097256		1
59	1.270000	1.196121	-.076121		1
60	1.500000	1.105612	-.305612		1
61	1.260000	1.257256	-.097256		1
62	1.230000	1.202828	-.072828		1
63	1.500000	1.105612	-.305612		1
64	1.930000	2.103373	-.173373		1

NOTE - (*) INDICATES ESTIMATE CALCULATED WITH MEANS SUBSTITUTED
R INDICATES POINT OUT OF RANGE OF PLOT

NUMBER OF CASES PLOTTED	64	3, OR 4.69 PERCENT OF THE TOTAL
NUMBER OF 2 S.D. OUTLIERS	3	
VON NEUMANN RATIO	2.34692	DURBIN-WATSON TEST 2.31025
NUMBER OF POSITIVE RESIDUALS	19	
NUMBER OF NEGATIVE RESIDUALS	45	
NUMBER OF RUNS OF SIGNS	27	
EXPECTED NUMBER OF RUNS OF SIGNS	28	
EXPECTED S.D. OF RUN DISTRIBUTION	3.30265	
UNIT NORMAL DEVIATE		
Z = (EXPECTED-OBSERVED)/S.D.	-.06023	
PROBABILITY OF OBTAINING .GE. ABS(Z)	.47368	

APPENDIX EIGHT
COMPUTER RUN WITH 60 RAW DATA POINTS

APPENDIX EIGHT
COMPUTER RUN WITH 60 RAW DATA POINTS

MULTIPLE REGRESSION OF WEAPON ACQUISITION MEASUREMENTS

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FILE HARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION MEASUREMENTS DATA

***** MULTIPLE REGRESSION *****

VARIABLE	MEAN	STANDARD DEV	CASES
MISREQ	8.1167	2.8765	68
OPCHAR	45.1667	69.5397	68
DERSS	295.8667	141.7821	68
INTERFAC	57.5580	29.7819	68
TIME	11.6333	8.2441	68

CORRELATION COEFFICIENTS.

A VALUE OF 99.9999 IS PRINTED
IF A COEFFICIENT CANNOT BE COMPUTED.

OPCHAR	.11985		
DERSS	.89037	-.91654	
INTERFAC	-.51379	.34686	.53799
TIME	-.89603	-.14588	.17968
			.88950
MISREQ		OPCHAR	DERSS
			INTERFAC

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

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FILE WARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. MISREQ MISSION REQUIREMENTS

MEAN RESPONSE 8.11667 STD. DEV. 2.87651

VARIABLE(S) ENTERED ON STEP NUMBER 1.. TIME TIME FROM SPEC START

MULTIPLE R	ANALYSIS OF VARIANCE	OF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	.00603	REGRESSION	1.	.01774	.00211	.76
ADJUSTED R SQUARE	-.01720	RESIDUAL	50.	400.16568		
STD DEVIATION	2.90115	COEFF OF VARIABILITY	35.7 PCT			

VARIABLES IN THE EQUATION				VARIABLES NOT IN THE EQUATION			
VARIABLE	B	STD ERROR B	F	SIGNIFICANCE	BETA	ELASTICITY	ELASTICITY
TIME	-.21031106E-02	.45814295E-01	.21072790E-02	-.0060275			
(CONSTANT)	8.1411329	.65141205	156.19176	-.00301			

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
TIME	-.21031106E-02	.45814295E-01	-.45905117E-01	-.93810347E-01, .096004166E-01
CONSTANT	8.1411329	.65141205	12.497670	6.8371900, 9.4450750

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

TIME	.00210
TIME	

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

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FILE HARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. UPGAR OPERATIONAL CHARACTERISTICS

MEAN RESPONSE 95.1667 STD. DEV. 69.53969

VARIABLE(S) ENTERED ON STEP NUMBER 1. TIME TIME FROM SPEC START

MULTIPLE R	.14508	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	.02120	REGRESSION	1.	6871.83298	6871.83298	1.26117	.266
ADJUSTED R SQUARE	.00441	RESIDUAL	58.	279236.58836	4814.45698		
STD DEVIATION	69.38629	COEFF OF VARIABILITY	72.9 PCT				

----- VARIABLES IN THE EQUATION -----				----- VARIABLES NOT IN THE EQUATION -----			
VARIABLE	B	STD ERROR B	F	SIGNIFICANCE	BETA	ELASTICITY	
TIME	-1.2305275	1.8957330	1.2611668				
(CONSTANT)	189.48188	15.579727	49.381489				
			.088				

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
TIME	-1.2305275	1.8957330	-1.1230168	-3.9238771 ; .96282208
CONSTANT	189.48188	15.579727	12.821964	78.295591 ; 140.66882

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

TIME	1.28863
TIME	

FILE WARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE,, DESS DESIGN REUNT+SPEC STANDARDS

MEAN RESPONSE 295.06667 STD. DEV. 141.78286

VARIABLE(S) ENTERED ON STEP NUMBER 1.. TIME TIME FROM SPEC START

MULTIPLE R	.17968	ANALYSIS OF VARIANCE	OF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIF1
R SQUARE	.03226	REGRESSION	1.	30256.65208	30256.65208	1.93332	.17
ADJUSTED R SQUARE	.01557	RESIDUAL	50.	1147760.20045	19789.10628		
STD DEVIATION	140.63371	COEFF OF VARIABILITY	47.5 PCT				

VARIABLES IN THE EQUATION				VARIABLES NOT IN THE EQUATION			
VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL	TOLERANCE
			SIGNIFICANCE	ELASTICITY			F
TIME	3.6806468	2.2214989	1.9333107	.1796846			SIGNIFICANC
(CONSTANT)	259.93309	31.506348	67.721108	.12145			
			.888				

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
TIME	3.6806468	2.2214989	1.5944383	-1.3579512 ; 7.5356432
CONSTANT	259.93309	31.506348	8.2292880	196.78616 ; 323.10002

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

TIME 4.93502

TIME

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

FILE WARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. INTERFAC INTERFACE REQMTS

MEAN RESPONSE 57.55000 STD. DEV. 29.78386

VARIABLE(S) ENTERED ON STEP NUMBER 1.. TIME TIME FROM SPEC START

MULTIPLE R	.80950	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	.65528	REGRESSION	1.	416.99137	416.99137	.46835	.496
ADJUSTED R SQUARE	.64989	RESIDUAL	50.	51639.05863	1032.98113		
STD DEVIATION	29.83861	COEFF OF VARIABILITY	51.0 PCT				

----- VARIABLES IN THE EQUATION -----				----- VARIABLES NOT IN THE EQUATION -----			
VARIABLE	B	STD ERROR B	F	DELTA	VARIABLE	PARTIAL	TOLERANCE
TIME	.32247419	.47120586	.46834946	.0095003			
(CONSTANT)	53.798550	6.6998445	64.478821	.06519			
			.880				

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
TIME	.32247419	.47120586	.68436862	-.62074523 , 1.2656936
CONSTANT	53.798550	6.6998445	8.0290207	40.387154 , 67.209746

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

TIME .22243
TIME

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE... MISREU MISSION REQUIREMENTS

MEAN RESPONSE 0.11667 STD. DEV. 2.87651

VARIABLE(S) ENTERED ON STEP NUMBER 1.. INTERFAC INTERFACE REUNTS

MULTIPLE R	.31379	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	.09846	REGRESSION	1	40.06763	40.06763	6.33452	.015
ADJUSTED R SQUARE	.08292	RESIDUAL	58	400.11570	7.50020		
STD DEVIATION	2.75467	COEFF OF VARIABILITY	33.9 PCT				

VARIABLES IN THE EQUATION				VARIABLES NOT IN THE EQUATION			
VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL TOLERANCE	F
INTERFAC	-.30306971E-01	.12073425E-01	6.3345219	-.3137070	OPCHAR	.24500	.07960
(CONSTANT)	9.0654369	.70854639	159.74792	-.21545	DERSS	.33302	.71057
			.015				3.6652231
			0				7.1400042
							.010

***** DESIGN REQNT*SPEC STANDARDS *****

VARIABLE(S) ENTERED ON STEP NUMBER 2.. DERSS

MULTIPLE R	.49601	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	.24603	REGRESSION	2	97.11211	48.55605	7.07721	.0
ADJUSTED R SQUARE	.17002	RESIDUAL	57	391.07123	6.86090		
STD DEVIATION	2.01933	COEFF OF VARIABILITY	32.3 PCT				

VARIABLES IN THE EQUATION				VARIABLES NOT IN THE EQUATION			
VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL TOLERANCE	F
INTERFAC	-.49076727E-01	.13619133E-01	13.465901	-.5160779	OPCHAR	.36397	.02160
DERSS	.70286145E-02	.20532505E-02	7.1400042	-.35415			8.5510000
(CONSTANT)	0.7357746	.05403654	180.62000	.3760110			.005
			.010				

..... MULTIPLE REGRESSION

DEPENDENT VARIABLE.. MISHIO MISSION REQUIREMENTS

VARIABLE(S) ENTERED ON STEP NUMBER 1.. OPCUAR OPERATIONAL CHARACTERISTICS

MULTIPLE R .55731 ANALYSIS OF VARIANCE OF SUM OF SQUARES MEAN SQUARE F SIGNIFICANT
 R SQUARE .31505 REGRESSION 148.92000 49.64003 8.19376 0
 ADJUSTED R SQUARE .26702 RESIDUAL 339.26326 6.05027
 STD DEVIATION 2.46136 COEFF OF VARIABILITY 30.3 PCT

----- VARIABLES IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	BETA	ELASTICITY	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFICANT
INTERVAL	-.670.2274E-01	.14117015E-01	22.796248	-.6960205						
DELESS	.97132003E-02	.27703261E-02	12.257931	-.87791						
OPCUAR	.14066492E-01	.50837540E-02	8.5516800	.35407						
(CONSTANT)	7.707.3000	.87624569	77.361164	.17431						

----- VARIABLES NOT IN THE EQUATION -----

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
INTERVAL	-.670.2274E-01	.14117015E-01	-4.7745416	-.95602053E-01, -.39122495E-01
DELESS	.97132003E-02	.27703261E-02	3.5011329	.43560131E-02, .15270927E-01
OPCUAR	.14066492E-01	.50837540E-02	2.9241133	.46825008E-02, .25050476E-01
CONSTANT	7.707.3000	.87624569	8.7955195	5.9517450, 9.4623671

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

OPCUAR	.330003	
DELESS	-.000000	.000001
INTERVAL	-.000003	-.000002

OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SD	U.W
1.	11.00000	6.789651	2.210349		1
2.	0.00000	10.51600	-2.51600		1
3.	9.00000	6.515897	2.484103		1
4.	11.00000	6.792936	2.207064		1
5.	6.00000	6.379801	-2.379801		1
6.	6.00000	7.520632	.4793675		1
7.	6.00000	7.520632	.4793675		1
8.	11.00000	6.789651	2.210349		1
9.	11.00000	6.789651	2.210349		1
10.	11.00000	6.789651	2.210349		1
11.	11.00000	6.789651	2.210349		1
12.	11.00000	6.789651	2.210349		1
13.	6.00000	10.51600	-2.51600		1
14.	6.00000	10.51600	-2.51600		1
15.	6.00000	10.51600	-2.51600		1
16.	6.00000	10.51600	-2.51600		1
17.	9.00000	6.515897	2.484103		1
18.	9.00000	6.515897	2.484103		1
19.	9.00000	6.515897	2.484103		1
20.	9.00000	6.515897	2.484103		1
21.	9.00000	6.515897	2.484103		1
22.	3.00000	6.437112	-3.437112		1
23.	3.00000	6.437112	-3.437112		1
24.	3.00000	6.437112	-3.437112		1
25.	3.00000	6.437112	-3.437112		1
26.	3.00000	6.437112	-3.437112		1
27.	3.00000	6.437112	-3.437112		1
28.	3.00000	6.437112	-3.437112		1
29.	3.00000	6.437112	-3.437112		1
30.	11.00000	6.792936	2.207064		1
31.	6.00000	6.379801	-2.379801		1
32.	6.00000	6.379801	-2.379801		1
33.	6.00000	7.456508	.456508		1
34.	6.00000	7.456508	.456508		1
35.	6.00000	7.456508	.456508		1
36.	6.00000	7.456508	.456508		1
37.	6.00000	7.456508	.456508		1
38.	11.00000	6.910679	2.089321		1
39.	11.00000	6.910679	2.089321		1
40.	11.00000	6.910679	2.089321		1
41.	11.00000	6.910679	2.089321		1
42.	11.00000	6.910679	2.089321		1
43.	6.00000	6.478221	-2.478221		1
44.	7.00000	12.78793	-5.78793		1
45.	9.00000	12.55391	-3.55391		1
46.	11.00000	9.276429	1.723571		1
47.	9.00000	6.802807	2.197193		1
48.	11.00000	6.802807	2.197193		1
49.	11.00000	6.802807	2.197193		1
50.	11.00000	6.802807	2.197193		1

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MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

FILE NAME (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SD	R.M
53.	8.00000	7.187463	.8125367		1
54.	3.00000	5.580999	-2.580999		1
55.	3.00000	5.580999	-2.580999		1
56.	3.00000	5.580999	-2.580999		1
57.	8.00000	6.65414	1.34586		1
58.	11.00000	9.753122	1.246878		1
59.	11.00000	9.753122	1.246878		1
60.	11.00000	9.855999	1.144001		1

NOTE - (-) INDICATES ESTIMATE CALCULATED WITH MEANS SUBSTITUTED
 N INDICATES POINT OUT OF RANGE OF PLOT

NUMBER OF CASES PLOTTED 60. OR 1.67 PERCENT OF THE TOTAL
 NUMBER OF 2 S.D. OUTLIERS 1. OR 1.67 PERCENT OF THE TOTAL

VON NEUMANN RATIO .93136 DURNIN-WATSON TEST .91586

NUMBER OF POSITIVE RESIDUALS 18.
 NUMBER OF NEGATIVE RESIDUALS 22.
 NUMBER OF RUNS OF SIGNS 15.

EXPECTED NUMBER OF RUNS OF SIGNS 29.
 EXPECTED S.D. OF RUN DISTRIBUTION 3.56224
 UNIT NORMAL DEVIATE -3.75232
 Z=((EXPECTED-OBSERVED)/S.D.) .80989
 PROBABILITY OF OBTAINING .GE. ABS(Z)

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FILE NAME: (CREATION DATE = 31 AUG 78) MEASUREMENT REQUIREMENTS DATA
***** MULTIPLE REGRESSION *****
DEPENDENT VARIABLE: INTERFAC OPERATIONAL CHARACTERISTICS
MEAN RESPONSE 95.16667 STD. DEV. 69.53969
VARIABLE(S) ENTERED ON STEP NUMBER 1.. INTERFAC INTERFACE HEIGHTS

MULTIPLE R .34686 ANALYSIS OF VARIANCE DF SUM OF SQUARES
R SQUARE .12632 REGRESSION 1. 34327.16840
ADJUSTED R SQUARE .10515 RESIDUAL 50. 250983.16493
STD DEVIATION 65.78219 COEFF OF VARIABILITY 69.1 PCT

----- VARIABLES IN THE EQUATION -----
VARIABLE U STD ERROR H F SIGNIFICANCE ELASTICITY DELTA
INTERFAC .01230491 .28831641 7.9327064 .3468608 .9107
(CONSTANT) 88.433402 18.639643 6.7517486 .012

----- VARIABLES NOT IN THE EQUATION -----
VARIABLE PARTIAL TOLERANCE F SIGNIFICANCE
MISHER .24580 .90154 3.6652231
DERS .25695 .71457 4.0295041
.044

***** DESIGN HEIGHT-STEP STANDARDS *****
VARIABLE(S) ENTERED ON STEP NUMBER 2.. DERS9

MULTIPLE R .92237 ANALYSIS OF VARIANCE DF SUM OF SQUARES
R SQUARE .17844 REGRESSION 2. 54094.45964
ADJUSTED R SQUARE .14957 RESIDUAL 57. 234411.87370
STD DEVIATION 64.12669 COEFF OF VARIABILITY 67.4 PCT

----- VARIABLES IN THE EQUATION -----
VARIABLE U STD ERROR H F SIGNIFICANCE ELASTICITY DELTA
INTERFAC 1.1721358 .33343511 12.357574 .5060776
DERS -.14622644 .69855831-01 4.0295041 -.74442
(CONSTANT) 69.140473 26.909244 14.952579 -.43595

----- VARIABLES NOT IN THE EQUATION -----
VARIABLE PARTIAL TOLERANCE F SIGNIFICANCE
MISHER .36347 .80107 8.5516080
.005

```

FILE NAME (COMPUTATION DATE = 31 AUG 70) MEAFOD ACQUISITION REQUIREMENTS DATA

DEPENDENT VARIABLE... OPERATIONAL CHARACTERISTICS

VARIABLE(S) ENTERED ON STEP NUMBER 3... MISSED MISSION REQUIREMENTS

MULTIPLE R SQUARE
R SQUARE
ADJUSTED R SQUARE
STD DEVIATION

ANALYSIS OF VARIANCE
REGRESSION
RESIDUAL
COEFF OF VARIABILITY

SUM OF SQUARES
81952.65819
203357.67510
63.3 PCL

MEAN SQUARE
21317.55273
3631.59706

F SIGNIF
7.52262 O

VARIABLES IN THE EQUATION

VARIABLES NOT IN THE EQUATION

VARIABLE	B	STD ERROR B	F	SIGNIFICANCE	ELASTICITY	DELTA	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFICANCE
INTERFAC	1.6174844	.34837535	21.556852	.0000001	.6989401	.97814					
DEPSS	-.26820557	.69637374E-01	8.9392258	.0000001	-.4245031	-.64730					
MISSED	8.9111108	3.0472518	8.5516600	.0000002	.3666602	.76002					
(CONSTANT)	-.6470531	33.385968	.68304302E-01	.605	.76002						

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95% B PLT CONFIDENCE INTERVAL
INTERFAC	1.6174844	.34837535	4.6429357	.91960466 ; 2.3153640
DEPSS	-.26820557	.69637374E-01	-2.9088538	-.14770599 ; -.64705144E-01
MISSED	8.9111108	3.0472518	2.9243113	2.4467399 ; 15.015490
CONSTANT	-.6470531	33.385968	-.26135107	-70.926144 ; 57.632092

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

	MISSED	DEPSS	INTERFAC
MISSED	9.24574		
DEPSS	-.07684	.00465	
INTERFAC	.86807	-.01901	.12137

OBSERVATION	T VALUE	T ESTIMATE	RESIDUAL	W.W
1	61.00000	88.71658	-27.71658	1
2	69.00000	20.09053	40.09053	1
3	117.0000	155.09398	-38.09398	1
4	63.00000	92.91035	-29.91035	1
5	229.0000	118.9189	110.9189	1
6	121.0000	112.6224	8.377597	1
7	121.0000	112.6224	8.377597	1
8	61.00000	88.71658	-27.71658	1
9	61.00000	88.71658	-27.71658	1
10	61.00000	88.71658	-27.71658	1
11	61.00000	88.71658	-27.71658	1
12	61.00000	88.71658	-27.71658	1
13	69.00000	20.09053	40.09053	1
14	69.00000	20.09053	40.09053	1
15	69.00000	20.09053	40.09053	1
16	69.00000	20.09053	40.09053	1
17	117.0000	155.09398	-38.09398	1
18	117.0000	155.09398	-38.09398	1
19	117.0000	155.09398	-38.09398	1
20	117.0000	155.09398	-38.09398	1
21	117.0000	155.09398	-38.09398	1
22	16.00000	61.11300	-45.11300	1
23	16.00000	61.11300	-45.11300	1
24	16.00000	61.11300	-45.11300	1
25	16.00000	61.11300	-45.11300	1
26	16.00000	61.11300	-45.11300	1
27	16.00000	61.11300	-45.11300	1
28	16.00000	61.11300	-45.11300	1
29	16.00000	61.11300	-45.11300	1
30	63.00000	92.91035	-29.91035	1
31	229.0000	118.9189	110.9189	1
32	229.0000	118.9189	110.9189	1
33	150.0000	125.5297	20.47032	1
34	150.0000	125.5297	20.47032	1
35	150.0000	125.5297	20.47032	1
36	150.0000	125.5297	20.47032	1
37	150.0000	125.5297	20.47032	1
38	65.00000	91.19655	-26.19655	1
39	65.00000	91.19655	-26.19655	1
40	65.00000	91.19655	-26.19655	1
41	65.00000	91.19655	-26.19655	1
42	65.00000	91.19655	-26.19655	1
43	261.0000	135.5099	135.5099	1
44	305.0000	91.30323	269.6368	1
45	85.00000	52.05100	79.18802	1
46	85.00000	88.66695	-2.666951	1
47	120.0000	148.7033	-28.70334	1
48	71.00000	95.43995	-24.43995	1
49	71.00000	95.43995	-24.43995	1
50	71.00000	95.43995	-24.43995	1

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MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

FILE NAME (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****				
OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SD
53.	176.0000	141.6082	34.39179	
54.	19.00000	85.07154	-66.07154	
55.	19.00000	85.07154	-66.07154	
56.	19.00000	85.07154	-66.07154	
57.	208.0000	166.6225	41.37746	
58.	75.00000	77.53027	-2.530270	
59.	75.00000	77.53027	-2.530270	
60.	76.00000	75.82047	.1795345	

NOTE - (*) INDICATES ESTIMATE CALCULATED WITH MEANS SUBSTITUTED
 R INDICATES POINT OUT OF RANGE OF PLOT

NUMBER OF CASES PLOTTED 60.
 NUMBER OF 2 S.D. OUTLIERS 2, OR 3.33 PERCENT OF THE TOTAL
 VON NEUMANN RATIO 1.01003 DURBIN-WATSON TEST .99319
 NUMBER OF POSITIVE RESIDUALS 22.
 NUMBER OF NEGATIVE RESIDUALS 38.
 NUMBER OF RUNS OF SIGNS 16.
 EXPECTED NUMBER OF RUNS OF SIGNS 29.
 EXPECTED S.D. OF RUN DISTRIBUTION 3.56224
 UNIT NORMAL DEVIATE -1.07160
 Z = ((EXPECTED-OBSERVED)/S.D.)
 PROBABILITY OF OBTAINING .GE. ABS(Z) .00026

FILE NAME (CREATION DATE = 31 AUG 76) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. OLRSS DESIGN REQUIREMENT STANDARDS

MEAN RESPONSE 295.86667 STD. DEV. 191.74206

VARIABLE(S) ENTERED ON STEP NUMBER 1.. INTERFAC INTERFAC REQUIS

MULTIPLE R	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	.53799	1.	343276.91627	343276.91627	23.62511	0
ADJUSTED R SQUARE	.28943	58.	842750.82306	14530.17281		
STD DEVIATION	120.54117					

----- VARIABLES IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	ETA	ELASTICITY	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFICANC
INTERFAC	2.5679310	.52831926	23.625109	.5379910		MISREQ	.33382	.90154	7.1408442	
(CONSTANT)	100.08228	34.155817	18.796882	.49950		UPCHAR	-.25695	.87968	4.8295841	.049

----- VARIABLES NOT IN THE EQUATION -----

***** MULTIPLE REGRESSION *****

MULTIPLE R	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	.60714	2.	43719.11973	21859.55937	16.63897	0
ADJUSTED R SQUARE	.36862	57.	78837.82268	13137.50566		
STD DEVIATION	114.61896					

----- VARIABLES IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	ETA	ELASTICITY	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFICANC
INTERFAC	3.118104	.52908513	52.004812	.609854		UPCHAR	-.37182	.82654	8.9392258	.004
MISREQ	19.60757	5.4635261	7.1408442	.58548						

----- VARIABLES NOT IN THE EQUATION -----

FILE NAME LOCATION DATE = 31 AUG 70 MECHAN ACQUISITION REQUIREMENTS DATA

DEPENDENT VARIABLE.. DEPENDENT VARIABLE.. MULTIPLE REGRESSION

VARIABLE(S) ENTERED ON STEP NUMBER 3.. OPERATOR OPERATIONAL CHARACTERISTICS

MULTIPLE R .67493 ANALYSIS OF VARIANCE OF SUM OF SQUARES MEAN SQUARE F SIGNIFICANT
R SQUARE .45553 REGRESSION 3. 540270.57378 180090.19126 15.61742
ADJUSTED R SQUARE .42636 RESIDUAL 56. 645756.35955 11531.36356
STD DEVIATION 107.30419 COEFF OF VARIABILITY 36.3 PCT

----- VARIABLES IN THE EQUATION -----
VARIABLE B STD ERROR B F SIGNIFICANCE BETA ELASTICITY
INTERFAC 3.6666198 .54191637 45.779096 .7681704
MISREU 18.448342 5.2806742 12.257931 .71321
OPCHAM -.66115070 .22113145 8.9392258 .58720
(CONSTANT) -2.2915036 50.993038 .15087865E-02 -.21266
----- VARIABLES NOT IN THE EQUATION -----
VARIABLE PARTIAL TOLERANCE F SIGNIFICANT

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE B STD ERROR B T 95.0 PCT CONFIDENCE INTERVAL
INTERFAC 3.6666198 .54191637 6.7666251 2.5810308 , 4.7522007
MISREU 18.448342 5.2806742 3.5011329 7.4090004 , 29.4860000
OPCHAM -.66115070 .22113145 -2.9898538 -1.1091302 , -.21817110
CONSTANT -2.2915036 50.993038 -.38843101E-01 -120.47036 , 115.88736

VARIABLE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

MISREU 27.88552
OPCHAM -.28775 .40000
INTERFAC 1.00000 -.00000 .29367

OBSERVATION	T VALUE	Y ESTIMATE	RESIDUAL	-2SD	W.W
1.	143.0000	226.7092	-83.70922		1.
2.	364.0000	195.3279	166.6721		1.
3.	531.0000	526.7033	4.256682		1.
4.	206.0000	312.4259	-16.42594		1.
5.	149.0000	184.5655	-35.56547		1.
6.	94.0000	223.2006	-129.2006		1.
7.	94.0000	226.7092	-83.70922		1.
8.	143.0000	226.7092	-83.70922		1.
9.	143.0000	226.7092	-83.70922		1.
10.	143.0000	226.7092	-83.70922		1.
11.	143.0000	226.7092	-83.70922		1.
12.	143.0000	195.3279	166.6721		1.
13.	364.0000	195.3279	166.6721		1.
14.	364.0000	195.3279	166.6721		1.
15.	364.0000	195.3279	166.6721		1.
16.	364.0000	526.7033	4.256682		1.
17.	531.0000	526.7033	4.256682		1.
18.	531.0000	526.7033	4.256682		1.
19.	531.0000	526.7033	4.256682		1.
20.	531.0000	526.7033	4.256682		1.
21.	531.0000	526.7033	4.256682		1.
22.	275.0000	269.9255	5.074061		1.
23.	275.0000	269.9255	5.074061		1.
24.	275.0000	269.9255	5.074061		1.
25.	275.0000	269.9255	5.074061		1.
26.	275.0000	269.9255	5.074061		1.
27.	275.0000	269.9255	5.074061		1.
28.	275.0000	269.9255	5.074061		1.
29.	275.0000	332.4259	-16.42594		1.
30.	206.0000	184.5655	-35.56547		1.
31.	149.0000	223.2006	-129.2006		1.
32.	149.0000	226.7092	-83.70922		1.
33.	133.0000	251.7733	-116.7733		1.
34.	133.0000	251.7733	-116.7733		1.
35.	133.0000	251.7733	-116.7733		1.
36.	133.0000	251.7733	-116.7733		1.
37.	133.0000	251.7733	-116.7733		1.
38.	312.0000	312.4259	-2.70255		1.
39.	312.0000	312.4259	-2.70255		1.
40.	312.0000	312.4259	-2.70255		1.
41.	312.0000	312.4259	-2.70255		1.
42.	312.0000	312.4259	-2.70255		1.
43.	206.0000	223.2006	-129.2006		1.
44.	632.0000	243.5741	359.4293		1.
45.	613.0000	261.5531	-9.55311		1.
46.	292.0000	535.7591	49.24027		1.
47.	505.0000	146.4691	9.530311		1.
48.	316.0000	326.4691	9.530311		1.
49.	316.0000	326.4691	9.530311		1.
50.	336.0000	326.4691	9.530311		1.

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MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

FILE NAME (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

MULTIPLE REGRESSION				RESIDUAL		D.M
OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SD		
53.	149.0000	278.5829	-129.5829			1
54.	292.0000	330.2746	-38.2746			1
55.	292.0000	330.2746	-38.2746			1
56.	292.0000	330.2746	-38.2746			1
57.	192.0000	334.8258	-142.8258			1
58.	422.0000	323.0251	98.9749			1
59.	422.0000	323.0251	98.9749			1
60.	438.0000	326.0306	111.9694			1

NOTE - (-) INDICATES ESTIMATE CALCULATED WITH MEANS SUBSTITUTED
 N INDICATES POINT OUT OF RANGE OF PLUT

NUMBER OF CASES PLOTTED 60.
 NUMBER OF 2 S.D. OUTLIERS 2. OR 3.33 PERCENT OF THE TOTAL
 VON NEUMANN RATIO .9080 DURNIN-WATSON TEST .89294
 NUMBER OF POSITIVE RESIDUALS 30.
 NUMBER OF NEGATIVE RESIDUALS 30.
 NUMBER OF RUNS OF SIGNS 10.
 EXPECTED NUMBER OF RUNS OF SIGNS 11.
 EXPECTED S.D. OF RUN DISTRIBUTION 3.64422
 UNIT NORMAL DEViate -5.33051
 Z=(EXPECTED-OBSERVED)/S.D. .00000
 PROBABILITY OF OBTAINING .GE. ABS(7)

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. INICKFAC INTERFACE HEIGHTS

MEAN RESPONSE 57.55000 STD. DEV. 29.70386

VARIABLE(S) ENTERED ON STEP NUMBER 1.. DERSS DESIGN HEIGHT+SPEC STANDARDS

MULTIPLE R	.53799	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	.28943	REGRESSION	1.	15067.83948	15067.83948	23.62511	.0
ADJUSTED R SQUARE	.27718	RESIDUAL	58.	36909.81052	637.75535		
STD DEVIATION	25.25362	COEFF OF VARIABILITY	43.9 PCT				

----- VARIABLES IN THE EQUATION -----				----- VARIABLES NOT IN THE EQUATION -----			
VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL TOLERANCE	F
DERSS	.1127110	.2318080E-01	23.625109	.5379910	MISREQ	-.43715	.99032
(CONSTANT)	24.282543	7.5960557	10.151862	.57945	OPCHAR	.42210	.99973
			.002				.001

***** MULTIPLE REGRESSION *****

VARIABLE(S) ENTERED ON STEP NUMBER 2.. MISREQ MISSION REQUIREMENTS

MULTIPLE R	.65209	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	.42522	REGRESSION	2.	22135.73976	11067.86988	21.08440	.0
ADJUSTED R SQUARE	.40505	RESIDUAL	57.	29921.11024	524.93176		
STD DEVIATION	22.91139	COEFF OF VARIABILITY	39.0 PCT				

----- VARIABLES IN THE EQUATION -----				----- VARIABLES NOT IN THE EQUATION -----			
VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL TOLERANCE	F
DERSS	.12134209	.2119.511E-01	52.900012	.5749112	OPCHAR	.52721	.90713
MISREQ	-.3.0237514	1.0420006	13.965001	-.3762002			21.556852
(CONSTANT)	52.990091	10.90004	25.753169	-.53929			.000

FILE MARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA
 * * * * * MULTIPLE REGRESSION * * * * *
 DEPENDENT VARIABLE.. INTERFAC INTERFACE REUNTS
 VARIABLE(S) ENTERED ON STEP NUMBER 3.. OPCNAN OPERATIONAL CHARACTERISTICS
 MULTIPLE R .76400 ANALYSIS OF VARIANCE DF SUM OF SQUARES MEAN SQUARE F SIGNIFI
 R SQUARE .50498 REGRESSION 3. 30452.20301 10150.76114 26.31123 0
 ADJUSTED R SQUARE .56275 RESIDUAL 56. 21604.56459 385.79583
 STD DEVIATION 19.64169 COEFF OF VARIABILITY 34.1 PCT

VARIABLES IN THE EQUATION				VARIABLES NOT IN THE EQUATION			
VARIABLE	B	STD ERROR B	F SIGNIFICANCE	DELTA ELASTICITY	VARIABLE	PARTIAL TOLERANCE	F SIGNIFICANCE
DERSS	.12267124	.10130473E-01	45.779096	-.5055326			
MISRU	-.0.2922329	.09090325	22.796248	-.4156577			
OPCHN	.17104032	.37011135E-01	21.556052	-.64516			
(CONSTANT)	39.740023	9.3934037	17.898653	.20016			
			.000				

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
DERSS	.12267124	.10130473E-01	6.766251	.00351535E-01, .15899899
MISRU	-.0.2922329	.09090325	-4.7745416	-.6.6931128, -2.4913531
OPCHN	.17104032	.37011135E-01	4.6429357	.07690100E-01, .24590254
CONSTANT	39.740023	9.3934037	4.2306799	20.923414, 50.550232

VARIABLE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

	DERSS	MISRU	OPCHN
DERSS	.00033		
MISRU	-.00164	.00017	
OPCHN	.00002	-.00373	.00137

OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SD	0.0
1.	10.00000	20.55051	-2.550508	.	1
2.	26.00000	61.91227	-35.91227	.	1
3.	120.0000	86.35447	33.64553	.	1
4.	39.00000	30.43018	-5050249	.	1
5.	62.00000	71.61687	-9.616874	.	1
6.	43.00000	37.72674	5.273265	.	1
7.	41.00000	37.72674	5.273265	.	1
8.	10.00000	20.55051	-2.550508	.	1
9.	10.00000	20.55051	-2.550508	.	1
10.	10.00000	20.55051	-2.550508	.	1
11.	10.00000	20.55051	-2.550508	.	1
12.	10.00000	20.55051	-2.550508	.	1
13.	26.00000	61.91227	-35.91227	.	1
14.	26.00000	61.91227	-35.91227	.	1
15.	26.00000	61.91227	-35.91227	.	1
16.	26.00000	61.91227	-35.91227	.	1
17.	120.0000	86.35447	33.64553	.	1
18.	120.0000	86.35447	33.64553	.	1
19.	120.0000	86.35447	33.64553	.	1
20.	120.0000	86.35447	33.64553	.	1
21.	120.0000	86.35447	33.64553	.	1
22.	62.00000	63.34016	-1.340160	.	1
23.	62.00000	63.34016	-1.340160	.	1
24.	62.00000	63.34016	-1.340160	.	1
25.	62.00000	63.34016	-1.340160	.	1
26.	62.00000	63.34016	-1.340160	.	1
27.	62.00000	63.34016	-1.340160	.	1
28.	62.00000	63.34016	-1.340160	.	1
29.	62.00000	63.34016	-1.340160	.	1
30.	39.00000	30.43018	-5050249	.	1
31.	62.00000	71.61687	-9.616874	.	1
32.	62.00000	71.61687	-9.616874	.	1
33.	56.00000	47.49428	8.505717	.	1
34.	56.00000	47.49428	8.505717	.	1
35.	56.00000	47.49428	8.505717	.	1
36.	56.00000	47.49428	8.505717	.	1
37.	56.00000	47.49428	8.505717	.	1
38.	41.00000	40.74264	-7425956	.	1
39.	41.00000	40.74264	-7425956	.	1
40.	41.00000	40.74264	-7425956	.	1
41.	41.00000	40.74264	-7425956	.	1
42.	41.00000	40.74264	-7425956	.	1
43.	100.0000	80.52019	-7.520189	.	1
44.	100.0000	80.52019	-7.520189	.	1
45.	37.00000	49.68791	-52.68791	.	1
46.	37.00000	49.68791	-52.68791	.	1
47.	123.0000	93.49424	29.50576	.	1
48.	47.00000	45.94446	1.055540	.	1
49.	47.00000	45.94446	1.055540	.	1
50.	47.00000	45.94446	1.055540	.	1
51.	47.00000	45.94446	1.055540	.	1
52.	47.00000	45.94446	1.055540	.	1

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

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FILE NAME (CORRELATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

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***** MULTIPLE REGRESSION *****
OBSERVATION  Y VALUE  Y ESTIMATE  RESIDUAL  -2SD
53.  68.00000  53.92487  14.07513  1
54.  79.00000  65.94909  13.05091  1
55.  79.00000  65.94909  13.05091  1
56.  79.00000  65.94909  13.05091  1
57.  89.00000  64.69062  24.30138  1
58.  47.00000  57.18155  -10.18155  1
59.  47.00000  57.18155  -10.18155  1
60.  40.00000  59.31613  -11.31613  1

```

NOTE - (a) INDICATES ESTIMATE CALCULATED WITH MEANS SUBSTITUTED
 R INDICATES POINT OUT OF RANGE OF PLOT

```

NUMBER OF CASES PLOTTED  68.
NUMBER OF 2 S.D. OUTLIERS  2, OR  3.33 PERCENT OF THE TOTAL

VON NEUMANN RATIO  1.05329  DURBIN-WATSON TEST  1.03573

NUMBER OF POSITIVE RESIDUALS  26.
NUMBER OF NEGATIVE RESIDUALS  34.
NUMBER OF RUNS OF SIGNS  13.

EXPECTED NUMBER OF RUNS OF SIGNS  30.
EXPECTED S.D. OF RUN DISTRIBUTION  3.77050
UNIT NORMAL DEViate-
Z=(EXPECTED-OBSERVED)/S.D.  -4.49975
PROBABILITY OF OBTAINING .GE. ADS(2)  .00000

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COMPUTER RUN WITH 60 TRANSFORMED DATA POINTS

APPENDIX NINE

APPENDIX NINE
COMPUTER RUN WITH 60 TRANSFORMED DATA POINTS

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

FILE HARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

VARIABLE	MEAN	STANDARD DEV	CASES
MISPLQ	1.0075	.8356	60
OPCHAR	1.1200	.1753	60
DERSS	1.2630	.6106	60
INTERFAC	1.1402	.2355	60
TIME	15.1333	7.7229	60

CORRELATION COEFFICIENTS.

A VALUE OF 99.9999 IS PRINTED
IF A COEFFICIENT CANNOT BE COMPUTED.

OPCHAR	.47420		
DERSS	.86721	.76090	
INTERFAC	.95170	.95727	.69115
TIME	.91430	.34225	.14226
			.34604
MISPLQ	OPCHAR	DERSS	INTERFAC

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

31 AUG 78 PAGE 3

FILE NAME (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. MISREQ MISSION REQUIREMENTS

MEAN RESPONSE 1.0750 STD. DEV. .03350

VARIABLE(S) ENTERED ON STEP NUMBER 1.. TIME TIME FROM SPEC START

MULTIPLE R	.91438	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	.83602	REGRESSION	1.	.00001	.00001	.01199	.913
ADJUSTED R SQUARE	.81703	RESIDUAL	50.	.06651	.00133		
STD DEVIATION	.03386	COEFF OF VARIABILITY	3.4 PCT				

----- VARIABLES IN THE EQUATION -----

----- VARIABLES NOT IN THE EQUATION -----

VARIABLE	U	STD ERROR H	F	DELTA	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFICANCE
			SIGNIFICANCE	ELASTICITY					
TIME	.02518945E-04	.57085791E-03	.10951752	.0103789					
(CONSTANT)	1.0066789	.06787927E-02	13054.360	.00001					

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
TIME	.02518945E-04	.57085791E-03	.10951752	-.10001773E-02, .12052152E-02
CONSTANT	1.0066789	.06787927E-02	115.99297	.90930603, 1.0240514

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

TIME

TIME

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

31 AUG 78 PAGE 5

FILE WARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. OPCHAR OPERATIONAL CHARACTERISTICS

MEAN RESPONSE 1.12483 STD. DEV. .17534

VARIABLE(S) ENTERED ON STEP NUMBER 1.. TIME TIME FROM SPEC START

MULTIPLE R	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	.34225	REGRESSION	1.	.21247	.21247	7.69524
ADJUSTED R SQUARE	.11714	RESIDUAL	56.	1.68139	.02761	0
STD DEVIATION	.16616	COEFF OF VARIABILITY	19.6 %			

VARIABLES IN THE EQUATION				VARIABLES NOT IN THE EQUATION			
VARIABLE	B	STD ERROR B	F	SIGNIFICANCE	BETA	ELASTICITY	ELASTICITY
TIME	.7773471E-02	.28011037E-02	7.6952449	.007	.3422506		
(CONSTANT)	1.0107028	.42505376E-01	572.32034	.000	.09105		

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
TIME	.7773471E-02	.28011037E-02	2.7740304	.21633207E-02, .13377365E-01
CONSTANT	1.0107028	.42505376E-01	23.923301	.9335388A, 1.1840267

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

TIME	TIME
.00001	

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

31 AUG 78 . PAGE 7

FILE WARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. UERSS DESIGN REQUISITE STANDARDS

MEAN RESPONSE 1.26300 STD. DEV. .61455

VARIABLE(S) ENTERED ON STEP NUMBER 1.. TIME TIME FROM SPEC START

MULTIPLE R	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	.19226	REGRESSION	1.	.45896	1.19806	.28
ADJUSTED R SQUARE	.02024	RESIDUAL	50.	21.03198		
STD DEVIATION	.61352	COEFF OF VARIABILITY	48.6 PCT			

VARIABLES IN THE EQUATION				VARIABLES NOT IN THE EQUATION			
VARIABLE	B	STD ERROR B	F SIGNIFICANCE	BETA ELASTICITY	VARIABLE	PARTIAL TOLERANCE	F SIGNIFICANCE
TIME	.11320476E-01	.10342517E-01	1.1980554	.1422606			
(CONSTANT)	1.1193244	.15723000	50.223649	.11772			

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
TIME	.11320476E-01	.10342517E-01	1.0945572	-.93023205E-02, .32023272E-01
CONSTANT	1.1193244	.15723000	7.0866645	.79957836, 1.4290785

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

TIME .00111

TIME

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

31 AUG 78 PAGE 9

FILE WARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. INTERFAC INTERFACE REUNTS

MEAN RESPONSE 1.14817 STD. DEV. .23545

VARIABLE(S) ENTERED ON STEP NUMBER 1.. TIME TIME FROM SPEC START

MULTIPLE R	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	.34604	1.	.39166	.39166	7.88778	O
ADJUSTED R SQUARE	.11974	58.	2.67923	.04624		
STD DEVIATION	.10457					
	.22280					
	COEFF OF VARIABILITY	19.4 PCT				

----- VARIABLES IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFICANT
TIME	.18549977E-01	.37559927E-02	7.88778	.3460378					
(CONSTANT)	1.0096103	.5710186E-01	312.61308	.12068					

----- VARIABLES NOT IN THE EQUATION -----

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
TIME	.18549977E-01	.37559927E-02	2.8088740	.30316410E-02, .10000310E-01
CONSTANT	1.0096103	.5710186E-01	17.688865	.89538851, 1.1239121

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

TIME .00001

TIME


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DEPENDENT VARIABLE.. MISHQO MISSION REQUIREMENTS
MEAN RESPONSE 1.00750 STD. DEV. .03350
VARIABLE(S) ENTERED ON STEP NUMBER 1.. DERSS DESIGN REQMT=SHFC STANDARDS

MULTIPLE R .00721
R SQUARE .75205
ADJUSTED R SQUARE .74778
STD DEVIATION .01686

ANALYSIS OF VARIANCE
REGRESSION 1.
RESIDUAL 50.
COEFF OF VARIABILITY 1.7 PCT

SUM OF SQUARES
.05003
.01649

MEAN SQUARE
.05003
.00028

F 175.92126
SIGNIFI O

----- VARIABLES IN THE EQUATION -----
VARIABLE B STD ERROR B F SIGNIFICANCE DELTA ELASTICITY
DERSS .07383953E-01 .35724991E-02 175.92126 .0672101 .05990
(CONSTANT) .94765007 .50090000E-02 35780.030 0 0
M

----- VARIABLES NOT IN THE EQUATION -----
VARIABLE PARTIAL TOLERANCE F SIGNIFICANCE
OPCHAR -.50963 .41491 30.377960
INTERFAC -.01023 .52231 11.533026
M

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VARIABLE(S) ENTERED ON STEP NUMBER 2.. OPCHAR OPERATIONAL CHARACTERISTICS

MULTIPLE R .01556
R SQUARE .03625
ADJUSTED R SQUARE .03250
STD DEVIATION .01374

ANALYSIS OF VARIANCE
REGRESSION 2.
RESIDUAL 57.
COEFF OF VARIABILITY 1.4 PCT

SUM OF SQUARES
.05576
.01076

MEAN SQUARE
.02700
.00019

F 147.70313
SIGNIFI O

----- VARIABLES IN THE EQUATION -----
VARIABLE B STD ERROR B F SIGNIFICANCE HETA ELASTICITY
DERSS .06433319E-01 .45185331E-02 216.16019 1.2150071
OPCHAR -.07209212E-01 .15033730E-01 10.377960 .00320
(CONSTANT) 1.0214514 .13990200E-01 5327.4000 -.00711
M

----- VARIABLES NOT IN THE EQUATION -----
VARIABLE PARTIAL TOLERANCE F SIGNIFICANCE
INTERFAC .02075 .07956 12.045947
M

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FILE NAME (CREATION DATE = 31 AUG 78) WPAON ACQUISITION REQUIREMENTS DATA

DEPENDENT VARIABLE.. MISREQ MISSION REQUIREMENTS

VARIABLE(S) ENTERED ON STEP NUMBER 3.. INTERFAC INTERFACE REQMTS

MULTIPLE R .93117 ANALYSIS OF VARIANCE DF SUM OF SQUARES MEAN SQUARE F SIGNIFICANT
R SQUARE .8669 REGRESSION 3. .85767 .01922 121.56618 0
ADJUSTED R SQUARE .85976 RESIDUAL 56. .00886
STD DEVIATION .01257 COEFF OF VARIABILITY 1.2 PCT

----- VARIABLES IN THE EQUATION -----
VARIABLE B STD ERROR B F SIGNIFICANCE BETA ELASTICITY
DERSS .09677496E-01 .42398731E-02 270.07185 1.2752213
OPCHAM -.20596406 .37130644E-01 30.756186 .08735
INTERFAC .05553393E-01 .24649991E-01 12.005987 .22913
(CONSTANT) 1.0521196 .15563725E-01 4569.8627 .09750
----- VARIABLES NOT IN THE EQUATION -----
VARIABLE PARTIAL TOLERANCE F SIGNIFICANT

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
DERSS	.09677496E-01	.42398731E-02	16.433863	.61184010E-01, .78170983E-01
OPCHAM	-.20596406	.37130644E-01	-5.5450244	-.28836210, -.13156681
INTERFAC	.05553393E-01	.24649991E-01	3.4707271	.36173526E-01, .13493326
CONSTANT	1.0521196	.15563725E-01	67.680759	1.0209417, 1.0832975

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

	OPCHAM	DERSS	INTERFAC
OPCHAM	.00013		
DERSS	-.00004	.00002	
INTERFAC	-.00004	.00002	.00001

OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SD	0.0
1.	1.000000	1.001306	-.1306029E-02		1
2.	1.000000	1.001306	-.1306029E-02		1
3.	1.000000	1.001306	-.1306029E-02		1
4.	1.000000	1.001306	-.1306029E-02		1
5.	1.000000	1.001306	-.1306029E-02		1
6.	1.000000	1.001306	-.1306029E-02		1
7.	1.000000	1.000203	-.2029000E-03		1
8.	1.000000	1.001306	-.1306029E-02		1
9.	1.000000	1.001306	-.1306029E-02		1
10.	1.000000	1.001306	-.1306029E-02		1
11.	1.000000	1.001306	-.1306029E-02		1
12.	1.000000	1.001306	-.1306029E-02		1
13.	1.000000	1.001306	-.1306029E-02		1
14.	1.000000	.9999174	.0262369E-04		1
15.	1.000000	1.001954	-.1954347E-02		1
16.	1.000000	1.001306	-.1306029E-02		1
17.	1.000000	1.001306	-.1306029E-02		1
18.	1.000000	1.001306	-.1306029E-02		1
19.	1.000000	1.001306	-.1306029E-02		1
20.	1.000000	1.001306	-.1306029E-02		1
21.	1.000000	1.014113	-.411255E-01		1
22.	1.000000	.9999174	.0262369E-04		1
23.	1.000000	1.001954	-.1954347E-02		1
24.	1.000000	1.001306	-.1306029E-02		1
25.	1.000000	1.001306	-.1306029E-02		1
26.	1.000000	1.001306	-.1306029E-02		1
27.	1.000000	1.001306	-.1306029E-02		1
28.	1.170000	1.167918	.2082310E-02		1
29.	1.000000	.9999174	.0262369E-04		1
30.	1.000000	1.001954	-.1954347E-02		1
31.	1.000000	1.001306	-.1306029E-02		1
32.	1.000000	1.001306	-.1306029E-02		1
33.	1.000000	1.001306	-.1306029E-02		1
34.	1.110000	1.055434	.7046622E-01		1
35.	1.000000	1.001306	-.1306029E-02		1
36.	1.000000	1.001306	-.1306029E-02		1
37.	1.000000	1.001954	-.1954347E-02		1
38.	1.000000	.9999174	.0262369E-04		1
39.	1.170000	1.167918	.2082310E-02		1
40.	1.000000	1.036027	.3662715E-01		1
41.	1.000000	1.001954	-.1954347E-02		1
42.	1.000000	.9999174	.0262369E-04		1
43.	1.000000	1.001306	-.1306029E-02		1
44.	1.000000	.9997335	.9266506E-02		1
45.	1.000000	.9999174	.0262369E-04		1
46.	1.000000	1.001306	-.1306029E-02		1
47.	1.000000	.9917082	.0231010E-02		1
48.	1.000000	.9997335	.9266506E-02		1
49.	1.000000				1

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

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FILE WARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

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***** MULTIPLE REGRESSION *****
OBSERVATION  Y VALUE  Y ESTIMATE  RESIDUAL  -2SD  0.0
53.  1.00000  .9917602  .0231010E-02  .
54.  1.00000  1.007303  -.734307E-02  .
55.  1.00000  .9895328  .1046715E-01  .
56.  1.00000  .9907335  .9266586E-02  .
57.  1.00000  1.017942  -.1794106E-01  .
58.  1.00000  .9895328  .1046715E-01  .
59.  1.00000  1.017942  -.1794106E-01  .
60.  1.00000  1.014740  -.1473905E-01  .

```

NOTE - (-) INDICATES ESTIMATE CALCULATED WITH MEANS SUBSTITUTED
 R INDICATES POINT OUT OF RANGE OF PLU1

```

NUMBER OF CASES PLOTTED 60.
NUMBER OF 2 S.D. OUTLIERS 2. OR 3.33 PERCENT OF THE TOTAL

VON NEUMANN RATIO 2.04307 DUNNIN-WATSON TEST 2.00901

NUMBER OF POSITIVE RESIDUALS 18.
NUMBER OF NEGATIVE RESIDUALS 42.
NUMBER OF RUNS OF SIGNS 23.

EXPECTED NUMBER OF RUNS OF SIGNS 26.
EXPECTED S.D. OF RUN DISTRIBUTION 3.21501
UNIT NORMAL DEVIATE -.01901
Z=(EXPECTED-OBSERVED)/S.D. .20051
PROBABILITY OF OBTAINING .GE. ABS(Z)

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DEPENDENT VARIABLE... UPCHAR OPERATIONAL CHARACTERISTICS

MEAN RESPONSE 1.12083 STD. DEV. .17534

VARIABLE(S) ENTERED ON STEP NUMBER 1.. INTERFAC INTERFACE MEQNTS

MULTIPLE R	.95727	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFIC
R SQUARE	.91637	REGRESSION	1.	1.66217	1.66217	635.54797	O
ADJUSTED R SQUARE	.91493	RESIDUAL	56.	.15169	.00262		
STD DEVIATION	.05114	COEFF OF VARIABILITY	4.6 PCT				

----- VARIABLES IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFIC
INTERFAC	.71205972	.20276777E-01	635.54797	.9572732	MISREQ	.16100	.79593	1.5330619	
(CONSTANT)	.39235157	.33130944E-01	83.203891	.73024	DERSS	.49417	.52231	10.416769	.000

----- VARIABLES NOT IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFIC
MULTIPLE R	.96788				MEAN SQUARE	.04961		427.40644	O
R SQUARE	.93679					.00281			
ADJUSTED R SQUARE	.93458								
STD DEVIATION	.04485								

----- VARIABLES IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFIC
INTERFAC	.6114003	.34311904E-01	317.18968	.8206888	MISHLO	-.59581	.20622	30.756106	.000
DERSS	.50415650E-01	.13145977E-01	10.416769	.1477349					
(CONSTANT)	.34794054	.38916330E-01	126.50057	.46357					

DEPENDENT VARIABLE... UPCHAR OPERATIONAL CHARACTERISTICS

VARIABLE(S) ENTERED ON STEP NUMBER 3... MISREQ MISSION REQUIREMENTS

MULTIPLE R	.97939	ANALYSIS OF VARIANCE	OF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI.
R SQUARE	.95928	REGRESSION	3.	1.73986	.57995	430.86460	0
ADJUSTED R SQUARE	.95702	RESIDUAL	56.	.07400	.00132		
STD DEVIATION	.03635	COEFF OF VARIABILITY	3.2 PCT				

----- VARIABLES IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	ELASTICITY	BETA	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFICANCE
INTERFAC	.54170731	.30496251E-01	315.52690	.7274389						
DERSS	.15634600	.28934821E-01	95.77952	.55492						
MISREQ	-1.7212333	.31036555	30.756106	.17618						
(CONSTANT)	2.0355396	.30533076	44.44447	-1.54719						

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR	T	95.0 PCT CONFIDENCE INTERVAL
INTERFAC	.54170731	.30496251E-01	17.763079	.48861548 , .60279865
DERSS	.15634600	.28934821E-01	7.4685508	.11441092 , .19828269
MISREQ	-1.7212333	.31036555	-5.5458264	-2.3429702 , -1.0994984
CONSTANT	2.0355396	.30533076	6.6666706	1.4238886 , 2.6471906

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

MISREQ	.09633	
DERSS	-.00559	.014
INTERFAC	.00308	-.00493

OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SD	0.0
1.	1.00000	1.01236	-.123601E-01		1
2.	1.00000	1.01236	-.123601E-01		1
3.	1.00000	1.01236	-.123601E-01		1
4.	1.00000	1.01236	-.123601E-01		1
5.	1.00000	1.01236	-.123601E-01		1
6.	1.00000	1.01236	-.123601E-01		1
7.	1.00000	1.00000	-.398000E-03		1
8.	1.00000	1.01236	-.123601E-01		1
9.	1.00000	1.01236	-.123601E-01		1
10.	1.00000	1.01236	-.123601E-01		1
11.	1.00000	1.01236	-.123601E-01		1
12.	1.00000	1.01236	-.123601E-01		1
13.	1.00000	1.01236	-.123601E-01		1
14.	1.24000	1.24904	-.158962E-01		1
15.	1.43000	1.03792	-.799243E-02		1
16.	1.00000	1.01236	-.123601E-01		1
17.	1.00000	1.01236	-.123601E-01		1
18.	1.00000	1.01236	-.123601E-01		1
19.	1.00000	1.01236	-.123601E-01		1
20.	1.00000	1.01236	-.123601E-01		1
21.	1.50000	1.30019	-.119586		1
22.	1.24000	1.24904	-.158962E-01		1
23.	1.03000	1.03792	-.799243E-02		1
24.	1.00000	1.01236	-.123601E-01		1
25.	1.00000	1.01236	-.123601E-01		1
26.	1.00000	1.01236	-.123601E-01		1
27.	1.00000	1.01236	-.123601E-01		1
28.	1.57000	1.59675	-.286753E-01		1
29.	1.24000	1.24904	-.158962E-01		1
30.	1.03000	1.03792	-.799243E-02		1
31.	1.00000	1.01236	-.123601E-01		1
32.	1.00000	1.01236	-.123601E-01		1
33.	1.00000	1.01236	-.123601E-01		1
34.	1.23000	1.19371	-.762693E-01		1
35.	1.00000	1.01236	-.123601E-01		1
36.	1.00000	1.01236	-.123601E-01		1
37.	1.03000	1.03792	-.799243E-02		1
38.	1.24000	1.24904	-.158962E-01		1
39.	1.57000	1.59675	-.286753E-01		1
40.	1.00000	1.55716	-.1837157		1
41.	1.03000	1.044206	-.142403E-01		1
42.	1.03000	1.03792	-.799243E-02		1
43.	1.24000	1.24904	-.158962E-01		1
44.	1.00000	1.01236	-.123601E-01		1
45.	1.13000	1.06625	-.639752E-01		1
46.	1.24000	1.24904	-.158962E-01		1
47.	1.00000	1.01236	-.123601E-01		1
48.	1.45000	1.401597	-.448402E-01		1
49.	1.13000	1.06625	-.639752E-01		1
50.	1.00000	1.01236	-.123601E-01		1

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MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

FILE WARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

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***** MULTIPLE REGRESSION *****
OBSERVATION  Y VALUE  Y ESTIMATE  RESIDUAL  -2SD
53.  1.450000  1.401597  .04840209E-01  1
54.  1.720000  1.712699  -.0269936E-01  1
55.  1.190000  1.168002  .02199701E-01  1
56.  1.130000  1.066025  .6397527E-01  1
57.  1.190000  1.220251  -.3025077E-01  1
58.  1.190000  1.168002  .02199701E-01  1
59.  1.190000  1.220251  -.3025077E-01  1
60.  1.210000  1.219017  -.0016095E-02  1

```

NOTE - (*) INDICATES ESTIMATE CALCULATED WITH MEANS SUBSTITUTED
 R INDICATES POINT OUT OF RANGE OF PLOT

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NUMBER OF CASES PLOTTED 60.
NUMBER OF 2 S.D. OUTLIERS 3. OR 5.00 PERCENT OF THE TOTAL
VON NEUMANN RATIO 1.70642 DURBIN-WATSON TEST 1.75664
NUMBER OF POSITIVE RESIDUALS 17.
NUMBER OF NEGATIVE RESIDUALS 43.
NUMBER OF RUNS OF SIGNS 23.
EXPECTED NUMBER OF RUNS OF SIGNS 25.
EXPECTED S.D. OF RUN DISTRIBUTION 3.18649
UNIT NORMAL DEVIATE-
Z=(EXPECTED-OBSERVED)/S.D. -.60009
PROBABILITY OF OBTAINING .GE. ABS(Z) .27196

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FILE HARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA
 * * * * * M U L T I P L E R E G R E S S I O N * * * * *
 DEPENDENT VARIABLE.. DERSS DESIGN REQUISITE SPEC STANDARDS
 MEAN RESPONSE 1.26300 STD. DEV. .61455
 VARIABLE(S) ENTERED ON STEP NUMBER 1.. MISREQ MISSION REQUIREMENTS

MULTIPLE R	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFIC
R SQUARE	.06721	1.	16.75798	16.75798	175.92126	O
ADJUSTED R SQUARE	.75295	58.	5.52496	.09526		
STD DEVIATION	.74770					
	.30064					
	COEFF OF VARIABILITY	24.4 PCT				

----- VARIABLES IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFIC
MISREQ	15.071477	1.1966253	175.92126	.0672141	OPCHAR	.00672	.77513	106.23049	O
(CONSTANT)	-14.727513	1.2062502	149.06500	12.66074	INIFHAC	.67395	.79593	47.435403	O

----- VARIABLES NOT IN THE EQUATION -----

----- VARIABLES IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFIC
MISREQ	11.911609	.01018490	216.16079	.6508400	INTERFAC	-.46580	.00362	15.516706	O
OPCHAR	1.5991879	.15515026	106.23049	.4562635					

----- VARIABLES NOT IN THE EQUATION -----

----- VARIABLES IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFIC
MISREQ	11.911609	.01018490	216.16079	.6508400	INTERFAC	-.46580	.00362	15.516706	O
OPCHAR	1.5991879	.15515026	106.23049	.4562635					

----- VARIABLES NOT IN THE EQUATION -----

FILE NAME (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA
 ***** MULTIPLE REGRESSION *****
 DEPENDENT VARIABLE.. DEKSS DESIGN REFM+SPEC STANDARDS
 VARIABLE(S) ENTERED ON STEP NUMBER 3.. INTERFAC INTERFACE RECHTS
 MULTIPLE R .96551 ANALYSIS OF VARIANCE DF SUM OF SQUARES MEAN SQUARE F SIGNIFI
 R SQUARE .93229 REGRESSION 3, 20.77219 6.92485 256.66410 O
 ADJUSTED R SQUARE .92857 RESIDUAL 56, 1.51872 .02698
 STD DEVIATION .10425 COEFF OF VARIABILITY 13.0 PCT

----- VARIABLES IN THE EQUATION -----
 VARIABLE B STD ERROR B F SIGNIFICANCE BETA ELASTICITY
 MISREW 11.087833 .72332557 270.07105 .0495019
 OPCHAR 3.1917030 .02735239 55.779252 .000 9.40233
 INTERFAC -1.2371013 .31405403 15.516766 .000 2.83244
 (CONSTANT) -12.070155 .67507615 363.46450 .000 -1.12462

----- VARIABLES NOT IN THE EQUATION -----
 VARIABLE PARTIAL TOLERANCE F SIGNIFICANCE

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
MISREW	11.087833	.72332557	16.931063	10.910030 , 13.336028
OPCHAR	3.1917030	.02735239	7.4085500	2.3356133 , 4.0477920
INTERFAC	-1.2371013	.31405403	-3.931351	-1.8662271 , -.60797504
CONSTANT	-12.070155	.67507615	-19.064745	-14.222495 , -11.517015

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

MISREW	.52124	
OPCHAR	-.05004	.10203
INTERFAC	.04196	-.12697

OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SD	0.0
1.	1.00000	.9714003	.2851970E-01		1
2.	1.00000	.9714003	.2851970E-01		1
3.	1.00000	.9714003	.2851970E-01		1
4.	1.00000	.9714003	.2851970E-01		1
5.	1.00000	.9714003	.2851970E-01		1
6.	1.00000	.9714003	.2851970E-01		1
7.	1.00000	.9714003	.2851970E-01		1
8.	1.00000	.9714003	.2851970E-01		1
9.	1.00000	.9714003	.2851970E-01		1
10.	1.00000	.9714003	.2851970E-01		1
11.	1.00000	.9714003	.2851970E-01		1
12.	1.00000	.9714003	.2851970E-01		1
13.	1.00000	.9714003	.2851970E-01		1
14.	1.00000	.9714003	.2851970E-01		1
15.	1.00000	.9714003	.2851970E-01		1
16.	1.00000	.9714003	.2851970E-01		1
17.	1.00000	.9714003	.2851970E-01		1
18.	1.00000	.9714003	.2851970E-01		1
19.	1.00000	.9714003	.2851970E-01		1
20.	1.00000	.9714003	.2851970E-01		1
21.	1.00000	.9714003	.2851970E-01		1
22.	1.00000	.9714003	.2851970E-01		1
23.	1.00000	.9714003	.2851970E-01		1
24.	1.00000	.9714003	.2851970E-01		1
25.	1.00000	.9714003	.2851970E-01		1
26.	1.00000	.9714003	.2851970E-01		1
27.	1.00000	.9714003	.2851970E-01		1
28.	1.00000	.9714003	.2851970E-01		1
29.	1.00000	.9714003	.2851970E-01		1
30.	1.00000	.9714003	.2851970E-01		1
31.	1.00000	.9714003	.2851970E-01		1
32.	1.00000	.9714003	.2851970E-01		1
33.	1.00000	.9714003	.2851970E-01		1
34.	1.00000	.9714003	.2851970E-01		1
35.	1.00000	.9714003	.2851970E-01		1
36.	1.00000	.9714003	.2851970E-01		1
37.	1.00000	.9714003	.2851970E-01		1
38.	1.00000	.9714003	.2851970E-01		1
39.	1.00000	.9714003	.2851970E-01		1
40.	1.00000	.9714003	.2851970E-01		1
41.	1.00000	.9714003	.2851970E-01		1
42.	1.00000	.9714003	.2851970E-01		1
43.	1.00000	.9714003	.2851970E-01		1
44.	1.00000	.9714003	.2851970E-01		1
45.	1.00000	.9714003	.2851970E-01		1
46.	1.00000	.9714003	.2851970E-01		1
47.	1.00000	.9714003	.2851970E-01		1
48.	1.00000	.9714003	.2851970E-01		1
49.	1.00000	.9714003	.2851970E-01		1
50.	1.00000	.9714003	.2851970E-01		1
51.	1.00000	.9714003	.2851970E-01		1
52.	1.00000	.9714003	.2851970E-01		1

R

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MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

FILE WARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SD	0.0
53.	1.400000	1.692279	-.2102279		1
54.	1.900000	1.945000	-.4500000		1
55.	1.060000	1.243007	-.1830065		1
56.	1.170000	1.324597	-.1545966		1
57.	1.400000	1.256258	-.2237424		1
58.	1.060000	1.243007	-.1830065		1
59.	1.400000	1.256258	-.2237424		1
60.	1.530000	1.357205	-.1727953		1

NOTE - (*) INDICATES ESTIMATE CALCULATED WITH MEANS SUBSTITUTED
R INDICATES POINT OUT OF RANGE OF PLOT

NUMBER OF CASES PLOTTED 60.
NUMBER OF 2 S.D. OUTLIERS 2, OR 3.33 PERCENT OF THE TOTAL
VON NEUMANN RATIO 1.61914 DUBBIN-WATSON TEST 1.78882
NUMBER OF POSITIVE RESIDUALS 43.
NUMBER OF NEGATIVE RESIDUALS 17.
NUMBER OF RUNS OF SIGNS 21.

EXPECTED NUMBER OF RUNS OF SIGNS 25.
EXPECTED S.D. OF RUN DISTRIBUTION 3.10649
UNIT NORMAL DEVIATE
Z=(EXPECTED-OBSERVED)/S.D. -1.24470
PROBABILITY OF OBTAINING .GE. ABS(Z) .10662

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FILE      WARD      (CREATION DATE = 31 AUG 78)  WEAPON ACQUISITION MEASUREMENTS DATA
*****
DEPENDENT VARIABLE.. INTERFAC  INTERFACE RESULTS
MEAN RESPONSE      1.14817  STD. DEV.      .23545
VARIABLE(S) ENTERED ON STEP NUMBER 1.. OPCHAR  OPERATIONAL CHARACTERISTICS

MULTIPLE R      .95727  ANALYSIS OF VARIANCE OF  SUM OF SQUARES      MEAN SQUARE      F      SIGNIFIC
R SQUARE      .91637  REGRESSION      1.  2.99736      2.99736      635.54797  O
ADJUSTED R SQUARE      .91893  RESIDUAL      50.  .27354      .00472
STD DEVIATION      .06067  COEFF OF VARIABILITY      6.8 PCT

----- VARIABLES IN THE EQUATION -----
VARIABLE      B      STD ERROR H      F      SIGNIFICANCE      BETA      ELASTICITY      TOLERANCE      F      SIGNIFICANCE
OPCHAR      1.2854872      .50991007E-01  635.54797      .9572732      1.25488      .41493      2.9110940
(CONSTANT)  -.29265023      .57035994E-01  25.683619      .00000      .000      .77513      .42615486
                                           .000

*****
VARIABLE(S) ENTERED ON STEP NUMBER 2.. DERSS  DESIGN MECHANISPEC STANDARDS

MULTIPLE R      .95939  ANALYSIS OF VARIANCE OF  SUM OF SQUARES      MEAN SQUARE      F      SIGNIFIC
R SQUARE      .92044  REGRESSION      2.  3.01065      1.50533      329.70494  O
ADJUSTED R SQUARE      .91764  RESIDUAL      57.  .26824      .00457
STD DEVIATION      .06757  COEFF OF VARIABILITY      5.9 PCT

----- VARIABLES IN THE EQUATION -----
VARIABLE      B      STD ERROR H      F      SIGNIFICANCE      BETA      ELASTICITY      TOLERANCE      F      SIGNIFICANCE
OPCHAR      1.3471483      .77406713E-01  317.18968      1.0329780      1.35413      .42075      12.045947
DERSS      -.57919916E-01  .2222101E-01  2.9110940      -.0989736

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FILE WARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. INTERFAC INTERFACE PLDNTS

VARIABLE(S) ENTERED ON STEP NUMBER 3.. MISREQ MISSION REQUIREMENTS

MULTIPLE R	.96671	ANALYSIS OF VARIANCE	OF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	.93452	REGRESSION	3.	3.05672	1.01091	266.41396	0
ADJUSTED R SQUARE	.93101	RESIDUAL	56.	.21017	.00362		
STD DEVIATION	.06184	COEFF OF VARIABILITY	5.4 PCT				

----- VARIABLES IN THE EQUATION -----				----- VARIABLES NOT IN THE EQUATION -----			
VARIABLE	B	STD ERROR B	F SIGNIFICANCE	DELTA ELASTICITY	VARIABLE	PARTIAL TOLERANCE	F SIGNIFICAN

OPCHAR	1.5677667	.00259052E-01	315.52690	1.1674004			
DERSS	-.17530342	.04523330E-01	15.516706	1.53044			
MISREQ	2.0691951	.59610490	12.045947	-.19292			
(CONSTANT)	-2.4722030	.61221103	16.307220	.2950940			
			.001	1.01569			
			.000				

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
OPCHAR	1.5677667	.00259052E-01	17.761079	1.3909610 , 1.7445725
DERSS	-.17530342	.04523330E-01	-3.9391151	-.26851036 , -.00192066E-01
MISREQ	2.0691951	.59610490	3.4707271	.07409323 , 3.2634970
CONSTANT	-2.4722030	.61221103	-4.0302209	-3.6906494 , -1.2450373

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

DERSS	.03190	
MISREQ	-.02361	.35544
OPCHAR	-.00317	.00779

OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SD	W.H
1.	1.00000	.989351	.1066494E-01		1
2.	1.00000	.989351	.1066494E-01		1
3.	1.00000	.989351	.1066494E-01		1
4.	1.00000	.989351	.1066494E-01		1
5.	1.00000	.989351	.1066494E-01		1
6.	1.00000	.989351	.1066494E-01		1
7.	1.00000	.989351	.1066494E-01		1
8.	1.00000	.989351	.1066494E-01		1
9.	1.00000	.989351	.1066494E-01		1
10.	1.00000	.989351	.1066494E-01		1
11.	1.00000	.989351	.1066494E-01		1
12.	1.00000	.989351	.1066494E-01		1
13.	1.00000	.989351	.1066494E-01		1
14.	1.00000	.989351	.1066494E-01		1
15.	1.00000	.989351	.1066494E-01		1
16.	1.00000	.989351	.1066494E-01		1
17.	1.00000	.989351	.1066494E-01		1
18.	1.00000	.989351	.1066494E-01		1
19.	1.00000	.989351	.1066494E-01		1
20.	1.00000	.989351	.1066494E-01		1
21.	1.00000	.989351	.1066494E-01		1
22.	1.00000	.989351	.1066494E-01		1
23.	1.00000	.989351	.1066494E-01		1
24.	1.00000	.989351	.1066494E-01		1
25.	1.00000	.989351	.1066494E-01		1
26.	1.00000	.989351	.1066494E-01		1
27.	1.00000	.989351	.1066494E-01		1
28.	1.00000	.989351	.1066494E-01		1
29.	1.00000	.989351	.1066494E-01		1
30.	1.00000	.989351	.1066494E-01		1
31.	1.00000	.989351	.1066494E-01		1
32.	1.00000	.989351	.1066494E-01		1
33.	1.00000	.989351	.1066494E-01		1
34.	1.00000	.989351	.1066494E-01		1
35.	1.00000	.989351	.1066494E-01		1
36.	1.00000	.989351	.1066494E-01		1
37.	1.00000	.989351	.1066494E-01		1
38.	1.00000	.989351	.1066494E-01		1
39.	1.00000	.989351	.1066494E-01		1
40.	1.00000	.989351	.1066494E-01		1
41.	1.00000	.989351	.1066494E-01		1
42.	1.00000	.989351	.1066494E-01		1
43.	1.00000	.989351	.1066494E-01		1
44.	1.00000	.989351	.1066494E-01		1
45.	1.00000	.989351	.1066494E-01		1
46.	1.00000	.989351	.1066494E-01		1
47.	1.00000	.989351	.1066494E-01		1
48.	1.00000	.989351	.1066494E-01		1
49.	1.00000	.989351	.1066494E-01		1
50.	1.00000	.989351	.1066494E-01		1

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

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FILE WARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

MULTIPLE REGRESSION			
OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL
53.	1.580000	1.610646	-.3064605E-01
54.	2.070000	1.968202	-.1097100
55.	1.270000	1.276600	-.6607335E-02
56.	1.050000	1.163330	-.1133296
57.	1.260000	1.203027	-.5697330E-01
58.	1.270000	1.276600	-.6607335E-02
59.	1.260000	1.203027	-.5697330E-01
60.	1.230000	1.225613	-.4307135E-02

NOTE - (A) INDICATES ESTIMATE CALCULATED WITH MEANS SUBSTITUTED
R INDICATES POINT OUT OF RANGE OF PLOT

NUMBER OF CASES PLOTTED 60.
NUMBER OF \geq S.D. OUTLIERS 2. OR 3.33 PERCENT OF THE TOTAL

VON NEUMANN RATIO 2.00295 DURBIN-WATSON TEST 1.96957

NUMBER OF POSITIVE RESIDUALS 42.
NUMBER OF NEGATIVE RESIDUALS 16.
NUMBER OF RUNS OF SIGNS 25.

EXPECTED NUMBER OF RUNS OF SIGNS 26.
EXPECTED S.D. OF RUN DISTRIBUTION 3.21501
UNIT NORMAL DEVIATE-
2*(EXPECTED-OBSERVED)/S.D. -.21773
PROBABILITY OF OBTAINING .05. ABS(Z) .41302

APPENDIX TEN
COMPUTER RUN WITH 60 TRANSFORMED DATA POINTS
AND TIME ADDED AS AN INDEPENDENT VARIABLE

18 SEP 78 PAGE 2

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

FILE WARD (CREATION DATE = 18 SEP 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

VARIABLE	MEAN	STANDARD DEV	CASES
MISREQ	1.8875	.8336	60
OPCHAR	1.1288	.1753	60
DERSS	1.2638	.6146	60
INTERFAC	1.1482	.2355	60
TIME	13.1333	7.7229	60

CORRELATION COEFFICIENTS.

A VALUE OF 99.99999 IS PRINTED
IF A COEFFICIENT CANNOT BE COMPUTED.

OPCHAR	.87928	.76498	
DERSS	.86721	.95727	.69115
INTERFAC	.45174	.34225	.14226
TIME	.81438		.34684
MISREQ		OPCHAR	DERSS
			INTERFAC

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

10 SEP 78 PAGE 3

FILE HARD (CREATION DATE = 10 SEP 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. MISREQD MISSION REQUIREMENTS

MEAN RESPONSE 1.00750 STD. DEV. .03350

VARIABLE(S) ENTERED ON STEP NUMBER 1.. TIME TIME FROM SPEC START

MULTIPLE R	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE .01430	REGRESSION 1.	1.	.00001	.00001	.01199	.913
ADJUSTED R SQUARE -.01703	RESIDUAL 50.	50.	.06651	.00133		
STD DEVIATION .03306	COEFF OF VARIABILITY 3.4 PCT	3.4 PCT				

***** VARIABLES IN THE EQUATION *****

***** VARIABLES NOT IN THE EQUATION *****

VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFICANCE
TIME	.62510945E-04	.57005791E-03	.11994000E-01	.0143709					
(CONSTANT)	1.0066709	.06707927E-02	13454.368	.00001					

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
TIME	.62510945E-04	.57005791E-03	.10951752	-.10001773E-02, .12052152E-02
CONSTANT	1.0066709	.06707927E-02	115.99297	.90930643, 1.0240514

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

TIME	.00000
TIME	

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

FILE WARD (CREATION DATE = 10 SEP 78) WEAPON ACQUISITION REQUIREMENTS DATA

10 SEP 78 PAGE 5

DEPENDENT VARIABLE.. UPCHAR OPERATIONAL CHARACTERISTICS

MEAN RESPONSE 1.12003 STD. DEV. .17534

VARIABLE(S) ENTERED ON STEP NUMBER 1.. TIME TIME FROM SPEC START

MULTIPLE R	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
.34225	REGRESSION	1.	.21247	.21247	7.69524	O
.11714	RESIDUAL	58.	1.60139	.02761		
.10191	COEFF OF VARIABILITY	14.4 PCT				

VARIABLES IN THE EQUATION				VARIABLES NOT IN THE EQUATION			
VARIABLE	B	STD ERROR B	F	VARIABLE	PARTIAL	TOLERANCE	F
TIME	.77703471E-02	.20011037E-02	7.6952449				
(CONSTANT)	1.0107020	.42505376E-01	572.32434				

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
TIME	.77703471E-02	.20011037E-02	2.7748308	.21633207E-02, .13377365E-01
CONSTANT	1.0107020	.42505376E-01	23.923301	.93353000, 1.1040267

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

TIME .00001
TIME

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

IN SEP 78 PAGE 7

FILE WAND (CREATION DATE = 10 SEP 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. DERSS DESIGN HEIGHT+SPEC STANDARDS

MEAN RESPONSE 1.26300 STD. DEV. .61455

VARIABLE(S) ENTERED ON STEP NUMBER 1.. TIME TIME FROM SPEC START

MULTIPLE R	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	.14226	REGRESSION	1.	.45096	1.19006	.3
ADJUSTED R SQUARE	.02024	RESIDUAL	50.	21.03190		
STD DEVIATION	.61352	COEFF OF VARIABILITY	40.6 PCT			

----- VARIABLES IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFICANC
TIME	.11320476E-01	.10342517E-01	1.1900554	.1422606					
(CONSTANT)	1.1103244	.15723000	50.223649	.11712					

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
TIME	.11320476E-01	.10342517E-01	1.0945572	-.93023205E-02, .32023272E-01
CONSTANT	1.1103244	.15723000	7.0860645	.79957036, 1.4290705

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

TIME	.00011
TIME	

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS
 FILE WARD (CREATION DATE = 10 SEP 78) WEAPON ACQUISITION REQUIREMENTS DATA
 ***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. INTERFAC INTERFAC REGRNTS
 MEAN RESPONSE 1.14817 STD. DEV. .23545
 VARIABLE(S) ENTERED ON STEP NUMBER 1.. TIME TIME FROM SPEC START

MULTIPLE R	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	REGRESSION	1.	.39166	.39166	7.80978	0
ADJUSTED R SQUARE	RESIDUAL	50.	2.87923	.04964		
STD DEVIATION	COEFF OF VARIABILITY	19.4 PCT				

----- VARIABLES IN THE EQUATION -----
 VARIABLE B STD ERROR B F SIGNIFICANCE BETA ELASTICITY
 TIME .18549977E-01 .37559427E-02 7.8097802 .3460378 .12060
 (CONSTANT) 1.0096103 .57181060E-01 312.61380 0

----- VARIABLES NOT IN THE EQUATION -----
 VARIABLE PARTIAL TOLERANCE F SIGNIFICAN

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
TIME	.18549977E-01	.37559427E-02	2.4000760	.34316410E-02, .18668314E-01
CONSTANT	1.0096103	.57181060E-01	17.600065	.09530051, 1.1239121

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

TIME .02001
 TIME

COINTEGRATION DATE = 10 SEP 78) WEAPON ACQUISITION REQUIREMENTS DATA

MULTIPLE REGRESSION ANALYSIS

DEPENDENT VARIABLE...	HISREQ	MISSION REQUIREMENTS
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MEAN RESPONSE	1.00750	STD. DEV.	.03350
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WADSWORTH ENTERED ON STEP NUMBER	1.	DERSS	DESIGN HEIGHTS SPEC STANDARDS
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MULTIPLE R	.86721	ANALYSIS OF VARIANCE	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
			25.007	.65017	175.92126	.00000

R SQUARE	.75267	REGRESSION	
ADJUSTED R SQUARE	.74770	RESIDUAL	SA.
STD DEVIATION	.81686	COEFF OF VARIABILITY	1.7 PCT

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***** VARIABLES IN THE EQUATION *****
***** VARIABLES NOT IN THE EQUATION *****

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VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFICANCE
INTERCEPT	1.0000	.0000	1.0000		INTERCEPT				
AGE	.0000	.0000	1.0000		AGE				
SEX	.0000	.0000	1.0000		SEX				
EDUCATION	.0000	.0000	1.0000		EDUCATION				
INCOME	.0000	.0000	1.0000		INCOME				
WEALTH	.0000	.0000	1.0000		WEALTH				
DEBT	.0000	.0000	1.0000		DEBT				
LIABILITY	.0000	.0000	1.0000		LIABILITY				
NET WORTH	.0000	.0000	1.0000		NET WORTH				
ASSETS	.0000	.0000	1.0000		ASSETS				
LIABILITIES	.0000	.0000	1.0000		LIABILITIES				
NET ASSETS	.0000	.0000	1.0000		NET ASSETS				
NET LIABILITIES	.0000	.0000	1.0000		NET LIABILITIES				
NET WEALTH	.0000	.0000	1.0000		NET WEALTH				
NET DEBT	.0000	.0000	1.0000		NET DEBT				
NET INCOME	.0000	.0000	1.0000		NET INCOME				
NET EXPENSES	.0000	.0000	1.0000		NET EXPENSES				
NET SAVINGS	.0000	.0000	1.0000		NET SAVINGS				
NET INVESTMENT	.0000	.0000	1.0000		NET INVESTMENT				
NET CONSUMPTION	.0000	.0000	1.0000		NET CONSUMPTION				
NET DEBT TO GROSS ASSETS	.0000	.0000	1.0000		NET DEBT TO GROSS ASSETS				
NET DEBT TO NET ASSETS	.0000	.0000	1.0000		NET DEBT TO NET ASSETS				
NET DEBT TO NET LIABILITIES	.0000	.0000	1.0000		NET DEBT TO NET LIABILITIES				
NET DEBT TO NET WEALTH	.0000	.0000	1.0000		NET DEBT TO NET WEALTH				
NET DEBT TO NET INCOME	.0000	.0000	1.0000		NET DEBT TO NET INCOME				
NET DEBT TO NET EXPENSES	.0000	.0000	1.0000		NET DEBT TO NET EXPENSES				
NET DEBT TO NET SAVINGS	.0000	.0000	1.0000		NET DEBT TO NET SAVINGS				
NET DEBT TO NET INVESTMENT	.0000	.0000	1.0000		NET DEBT TO NET INVESTMENT				
NET DEBT TO NET CONSUMPTION	.0000	.0000	1.0000		NET DEBT TO NET CONSUMPTION				
NET DEBT TO NET DEBT TO GROSS ASSETS	.0000	.0000	1.0000		NET DEBT TO NET DEBT TO GROSS ASSETS				
NET DEBT TO NET DEBT TO NET ASSETS	.0000	.0000	1.0000		NET DEBT TO NET DEBT TO NET ASSETS				
NET DEBT TO NET DEBT TO NET LIABILITIES	.0000	.0000	1.0000		NET DEBT TO NET DEBT TO NET LIABILITIES				
NET DEBT TO NET DEBT TO NET WEALTH	.0000	.0000	1.0000		NET DEBT TO NET DEBT TO NET WEALTH				
NET DEBT TO NET DEBT TO NET INCOME	.0000	.0000	1.0000		NET DEBT TO NET DEBT TO NET INCOME				
NET DEBT TO NET DEBT TO NET EXPENSES	.0000	.0000	1.0000		NET DEBT TO NET DEBT TO NET EXPENSES				
NET DEBT TO NET DEBT TO NET SAVINGS	.0000	.0000	1.0000		NET DEBT TO NET DEBT TO NET SAVINGS				
NET DEBT TO NET DEBT TO NET INVESTMENT	.0000	.0000	1.0000		NET DEBT TO NET DEBT TO NET INVESTMENT				
NET DEBT TO NET DEBT TO NET CONSUMPTION	.0000	.0000	1.0000		NET DEBT TO NET DEBT TO NET CONSUMPTION				
NET DEBT TO NET DEBT TO NET DEBT TO GROSS ASSETS	.0000	.0000	1.0000		NET DEBT TO NET DEBT TO NET DEBT TO GROSS ASSETS				
NET DEBT TO NET DEBT TO NET DEBT TO NET ASSETS	.0000	.0000	1.0000		NET DEBT TO NET DEBT TO NET DEBT TO NET ASSETS				
NET DEBT TO NET DEBT TO NET DEBT TO NET LIABILITIES	.0000	.0000	1.0000		NET DEBT TO NET DEBT TO NET DEBT TO NET LIABILITIES				
NET DEBT TO NET DEBT TO NET DEBT TO NET WEALTH	.0000	.0000	1.0000		NET DEBT TO NET DEBT TO NET DEBT TO NET WEALTH				
NET DEBT TO NET DEBT TO NET DEBT TO NET INCOME	.0000	.0000	1.0000		NET DEBT TO NET DEBT TO NET DEBT TO NET INCOME				
NET DEBT TO NET DEBT TO NET DEBT TO NET EXPENSES	.0000	.0000	1.0000		NET DEBT TO NET DEBT TO NET DEBT TO NET EXPENSES				
NET DEBT TO NET DEBT TO NET DEBT TO NET SAVINGS									

DENSS	.47383953E+01	.35724991E+02	175.92126	.0672101	OPCHAR	-.58963	.41493	30.377963
(CONSTANT)	.90765067	.50898000E+02	35780.030	.05940	INTENFAC	-.41023	.52231	11.5333626
					TIME	-.22113	.97976	2.9305603

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OPERATIONAL CHARACTERISTICS

MULTIPLE R	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI-
.91556	REGRESSION	2.	.05576	.02788	147.70313	O
.0025	RESIDUAL	57.	.01076	.0019		
.87250	ADJUSTED R SQUARE					
.01374	COEFF OF VARIABILITY	1.4 PCT				
	STD DEVIATION					

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----- VARIABLES IN THE EQUATION -----
----- VARIABLES NOT IN THE EQUATION -----

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VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	TOLERANCE	F	SIGNIFICANCE
INTERCEPT	1.0000	.0000	1.0000		INTERCEPT	1.0000		
AGE	1.0000	.0000	1.0000		AGE	1.0000		
SEX	1.0000	.0000	1.0000		SEX	1.0000		
RELIGION	1.0000	.0000	1.0000		RELIGION	1.0000		
EDUCATION	1.0000	.0000	1.0000		EDUCATION	1.0000		
INCOME	1.0000	.0000	1.0000		INCOME	1.0000		
WEALTH	1.0000	.0000	1.0000		WEALTH	1.0000		
POWER	1.0000	.0000	1.0000		POWER	1.0000		
RESIDUAL	1.0000	.0000	1.0000		RESIDUAL	1.0000		

	DATE	TIME	INTE/FAC	INTE/FAC	TIME	INTE/FAC	INTE/FAC
DESS	060433319E-01	04510533E-02	216.16079	1.2155471	04320	0.07956	12.045548E-01
OPCIAM	-0.87289212E-01	0.15037305E-01	10.377900	-0.4557053	-0.00433	-0.27019606	0.001

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

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FILE WARD (CREATION DATE = 10 SEP 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. MISREQ MISSION REQUIREMENTS

VARIABLE(S) ENTERED ON STEP NUMBER 3.. INTERFAC INTERFACE REQNTS

MULTIPLE R	.93107	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	.86689	REGRESSION	3.	.85767	.01922	121.56618	O
ADJUSTED R SQUARE	.85976	RESIDUAL	56.	.88886	.00016		
STD DEVIATION	.01257	COEFF OF VARIABILITY	1.2 PCT				

----- VARIABLES IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	SIGNIFICANCE	BETA	ELASTICITY
DLRSS	.69677496E-01	.42398733E-02	270.07105		1.2752213	
OPCHAR	-.20596406	.37138644E-01	30.756106	.000	.00735	
INTERFAC	.85553393E-01	.24649991E-01	12.045947	.000	-.22913	
(CONSTANT)	1.0521196	.15563725E-01	4569.862	.000	.09750	

----- VARIABLES NOT IN THE EQUATION -----

VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFICANCE
TIME	-.01907	.00709	.20849171	.006

7472

FILE WARD (CREATION DATE = 10 SEP 7A) WEAPON ACQUISITION REQUIREMENTS DATA
 MULTIPLE REGRESSION
 DEPENDENT VARIABLE.. MISREQ MISSION REQUIREMENTS
 VARIABLE(S) ENTERED ON STEP NUMBER 4.. TIME TIME FROM SPEC START

MULTIPLE R .9311 ANALYSIS OF VARIANCE OF SUM OF SQUARES MEAN SQUARE F SIGNIFI-
 R SQUARE .8669 REGRESSION 4. .05767 .01442 89.58568 0
 ADJUSTED R SQUARE .85726 RESIDUAL 55. .00005 .00016
 STD DEVIATION .01269 COEFF OF VARIABILITY 1.3 PCT

VARIABLES IN THE EQUATION					VARIABLES NOT IN THE EQUATION				
VARIABLE	B	STD ERROR B	F	ELASTICITY	VARIABLE	PARTIAL TOLERANCE	F	SIGNIFICANCE	
DERSS	.69559547E-01	.43547336E-02	255.14691	1.2730626					
OPCHAR	-.20525965	.37704263E-01	29.511098	-.1.0717977					
INTERFAC	.05640360E-01	.24076339E-01	11.052901	-.22035					
TIME	-.33535044E-04	.23225350E-03	.20040171E-01	-.0077129					
(CONSTANT)	1.0510146	.15003063E-01	4407.5705	-.00044					

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
DERSS	.69559547E-01	.43547336E-02	15.973319	.60032066E-01, .78206629E-01
OPCHAR	-.20525965	.37704263E-01	-5.4320111	-.20090101, -.12953029
INTERFAC	.05640360E-01	.24076339E-01	3.4420003	.35791069E-01, .33509767
TIME	-.33535044E-04	.23225350E-03	-.14039242	-.40000206E-03, .43191077E-03
CONSTANT	1.0510146	.15003063E-01	66.309596	1.0200644, 1.0835640

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

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FILE WARD (CREATION DATE = 18 SEP 78) WEAPON ACQUISITION REQUIREMENTS DATA

DEPENDENT VARIABLE.. MISREQ MISSION REQUIREMENTS
MULTIPLE REGRESSION

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

OPCHAR	.00193		
DERSS	-.00008	.00002	
INTERFAC	-.00005	.00002	.00062
TIME	-.00000	.00000	-.00000
	OPCHAR	DERSS	INTERFAC
			TIME

OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-ZSD	U.M
1.	1.000000	1.001759	-.1750001E-02		1
2.	1.000000	1.001759	-.1750001E-02		1
3.	1.000000	1.001759	-.1750001E-02		1
4.	1.000000	1.001759	-.1750001E-02		1
5.	1.000000	1.001759	-.1750001E-02		1
6.	1.000000	1.001759	-.1750001E-02		1
7.	1.000000	1.000513	-.5131021E-03		1
8.	1.000000	1.001025	-.1024697E-02		1
9.	1.000000	1.001591	-.1591163E-02		1
10.	1.000000	1.001524	-.1524092E-02		1
11.	1.000000	1.001123	-.1322070E-02		1
12.	1.000000	1.001209	-.1209342E-02		1
13.	1.000000	1.001256	-.1255006E-02		1
14.	1.000000	1.000201	-.2012121E-03		1
15.	1.000000	1.002176	-.2176277E-02		1
16.	1.000000	1.001591	-.1591163E-02		1
17.	1.000000	1.001524	-.1524092E-02		1
18.	1.000000	1.001123	-.1322070E-02		1
19.	1.000000	1.001123	-.1322070E-02		1
20.	1.000000	1.001256	-.1255006E-02		1
21.	1.000000	1.001480	-.1480024E-02		1
22.	1.000000	1.000214	-.2141410E-03		1
23.	1.000000	1.002109	-.2109206E-02		1
24.	1.000000	1.001524	-.1524092E-02		1
25.	1.000000	1.001123	-.1322070E-02		1
26.	1.000000	1.001209	-.1209342E-02		1
27.	1.000000	1.001256	-.1255006E-02		1
28.	1.170000	1.167936	-.2064020E-02		1
29.	1.000000	1.000013	-.1292715E-04		1
30.	1.000000	1.001900	-.1907992E-02		1
31.	1.000000	1.001123	-.1322070E-02		1
32.	1.000000	1.001209	-.1209342E-02		1
33.	1.000000	1.001256	-.1255006E-02		1
34.	1.110000	1.035960	-.7404044E-01		1
35.	1.000000	1.001209	-.1209342E-02		1
36.	1.000000	1.001256	-.1255006E-02		1
37.	1.000000	1.001074	-.1070050E-02		1
38.	1.000000	.9999194	-.2060050E-04		1
39.	1.170000	1.167902	-.2097555E-02		1
40.	1.000000	1.036767	-.3676721E-01		1
41.	1.000000	1.000623	-.0623303E-02		1
42.	1.000000	1.001041	-.1040921E-02		1
43.	1.000000	.9994059	.5014010E-00		1
44.	1.000000	1.001256	-.1255006E-02		1
45.	1.000000	.9906459	.9364147E-02		1
46.	1.000000	.9999123	.0767979E-00		1
47.	1.000000	1.001222	-.1222271E-02		1
48.	1.000000	.9910042	.015791E-02		1
49.	1.000000	.9906123	.9307670E-02		1
50.	1.000000	1.001109	-.1100135E-02		1

R

R

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

FILE WARD (CREATION DATE = 18 SEP 70) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****									
OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SD	*****				
53:	1.000000	.9917501	.0289919E-02						
54:	1.000000	1.0017477	-.7477175E-02						
55:	1.000000	.9693193	.1860072E-01						
56:	1.000000	.9904446	.955356E-02						
57:	1.000000	1.017443	-.1740209E-01						
58:	1.000000	.9890045	.1091547E-01						
59:	1.000000	1.017342	-.1734249E-01						
60:	1.000000	1.014079	-.1407007E-01						

NOTE - (R) INDICATES ESTIMATE CALCULATED WITH MEANS SUBSTITUTED
R INDICATES POINT OUT OF RANGE OF PLOT

NUMBER OF CASES PLOTTED 60.
NUMBER OF 2 S.D. OUTLIERS 2, OR 3.33 PERCENT OF THE TOTAL
VON NEUMANN RATIO 2.04299 DURBIN-WATSON TEST 2.00094
NUMBER OF POSITIVE RESIDUALS 15,
NUMBER OF NEGATIVE RESIDUALS 45,
NUMBER OF RUNS OF SIGNS 19.
EXPECTED NUMBER OF RUNS OF SIGNS 24.
EXPECTED S.D. OF RUN DISTRIBUTION 2.86302
UNIT NORMAL DEVIATE
Z=((EXPECTED-OBSERVED)/S.D.)
PROBABILITY OF OBTAINING .GE. ABS(Z) -1.39693
 .00122

***** MULTIPLE REGRESSION *****
 DEPENDENT VARIABLE.. UPGHAN OPERATIONAL CHARACTERISTICS

MEAN RESPONSE 1.12803 STD. DEV. .17534

VARIABLE(S) ENTERED ON STEP NUMBER 1.. INTERFAC INTERFACE HEIGHTS

MULTIPLE R	.95727	ANALYSIS OF VARIANCE	OF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFIC
R SQUARE	.91637	REGRESSION	1.	1.66217	1.66217	635.54797	0
ADJUSTED R SQUARE	.91493	RESIDUAL	56.	.15169	.00262		
STD DEVIATION	.05114	COEFF OF VARIABILITY	4.6 PCT				

VARIABLES IN THE EQUATION				VARIABLES NOT IN THE EQUATION			
VARIABLE	B	STD ERROR B	F SIGNIFICANCE	BETA ELASTICITY	VARIABLE	PARTIAL TOLERANCE	F SIGNIFICANCE
INTERFAC	.71285972	.20276777E-01	635.54797	.9572732	MISREQ	.16188	.79593
(CONSTANT)	.39235157	.33130944E-01	83.283891	.73024	DERSS	.49417	.52231
			.000		TIME	.04053	.00026
							.93889948
							.761

***** DESIGN HEIGHT=SPEC STANDARDS *****

VARIABLES ENTERED ON STEP NUMBER 2.. DERSS				VARIABLES NOT IN THE EQUATION			
MULTIPLE R	.96708	ANALYSIS OF VARIANCE	OF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFIC
R SQUARE	.93629	REGRESSION	2.	1.69921	1.69921	422.40644	0
ADJUSTED R SQUARE	.93456	RESIDUAL	57.	.11465	.00281		
STD DEVIATION	.04485	COEFF OF VARIABILITY	4.0 PCT				

VARIABLES IN THE EQUATION				VARIABLES NOT IN THE EQUATION			
VARIABLE	B	STD ERROR B	F SIGNIFICANCE	BETA ELASTICITY	VARIABLE	PARTIAL TOLERANCE	F SIGNIFICANCE
INTERFAC	.61140803	.34311940E-01	317.14968	.9286884	MISREQ	-.59541	.20622
DERSS	.56415654E-01	.13145977E-01	18.416769	.62529	TIME	.12919	.06228
			.0	.1977389			.95044407

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

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FILE NAME (CREATION DATE = 18 SEP 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE: OPCAR OPERATIONAL CHARACTERISTICS

VARIABLE(S) ENTERED ON STEP NUMBER 3.. MISSED MISSION REQUIREMENTS

MULTIPLE R	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI-
R SQUARE	.97919					
ADJUSTED R SQUARE	.95920	3.	1.73984	.57995	430.86468	O
STD DEVIATION	.03635	56.	.07488	.00132		

VARIABLES IN THE EQUATION				VARIABLES NOT IN THE EQUATION			
VARIABLE	B	STD ERROR B	F SIGNIFICANCE	DELTA ELASTICITY	VARIABLE	PARTIAL TOLERANCE	F SIGNIFICANCE
INTERFAC	.50170731	.30096251E-01	315.52690	.7274309	TIME	.09269	.47660812
DERSS	.15634600	.20934021E-01	55.779252	.5479902			.093
MISREQ	-1.7212333	.31036555	30.756106	.17610			
(CONSTANT)	2.0355396	.30533076	44.444497	-1.50719			
			.000				

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

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FILE WARD (CREATION DATE = 18 SEP 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. UPGAR OPERATIONAL CHARACTERISTICS

VARIABLE(S) ENTERED ON STEP NUMBER 4.. TIME TIME FROM SPEC START

MULTIPLE R	.97957	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	.95955	REGRESSION	4.	1.74449	.43512	326.19165	0
ADJUSTED R SQUARE	.95661	RESIDUAL	55.	.07337	.00133		
STD DEVIATION	.03652	COEFF OF VARIABILITY	3.3 PCT				

----- VARIABLES IN THE EQUATION -----				----- VARIABLES NOT IN THE EQUATION -----			
VARIABLE	B	STD ERROR B	F SIGNIFICANCE	DELTA ELASTICITY	VARIABLE	PARTIAL TOLERANCE	F SIGNIFICANCE
INTERFAC	.53536124	.31900705E-01	200.09400	.7189170			
DERSS	.15625044	.21032910E-01	55.193494	.54842			
MISREQ	-1.7012493	.31316653	29.511090	.17600			
TIME	.45973059E-03	.06509064E-03	.4766612	-.152923			
(CONSTANT)	2.0167650	.30797035	42.003707	.00539			

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
INTERFAC	.53536124	.31900705E-01	16.735904	.47125420 , .59946020
DERSS	.15625044	.21032910E-01	7.4292324	.11410753 , .19840935
MISREQ	-1.7012493	.31316653	-5.4324111	-2.3288491 , -1.0736496
TIME	.45973059E-03	.06509064E-03	.6981156	-.07473600E-03 , .17942133E-02
CONSTANT	2.0167650	.30797035	6.5405714	1.3995794 , 2.6339522

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

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FILE WARD (CREATION DATE = 10 SEP 70) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. OPCMAR OPERATIONAL CHARACTERISTICS

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

MISREU	.09007		
DERSS	-.00505	.00044	
INTERFAC	.00365	-.00043	.00102
TIME	.00002	-.00000	-.00001
			.00000
MISREU	DERSS	INTERFAC	TIME

OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SD	U.W
1.	1.00000	1.007136	-.7136143E-02		1
2.	1.00000	1.007136	-.7136143E-02		1
3.	1.00000	1.007136	-.7136143E-02		1
4.	1.00000	1.007136	-.7136143E-02		1
5.	1.00000	1.007136	-.7136143E-02		1
6.	1.00000	1.007136	-.7136143E-02		1
7.	1.00000	1.007136	-.7136143E-02		1
8.	1.00000	1.007136	-.7136143E-02		1
9.	1.00000	1.007136	-.7136143E-02		1
10.	1.00000	1.007136	-.7136143E-02		1
11.	1.00000	1.007136	-.7136143E-02		1
12.	1.00000	1.007136	-.7136143E-02		1
13.	1.00000	1.007136	-.7136143E-02		1
14.	1.00000	1.007136	-.7136143E-02		1
15.	1.00000	1.007136	-.7136143E-02		1
16.	1.00000	1.007136	-.7136143E-02		1
17.	1.00000	1.007136	-.7136143E-02		1
18.	1.00000	1.007136	-.7136143E-02		1
19.	1.00000	1.007136	-.7136143E-02		1
20.	1.00000	1.007136	-.7136143E-02		1
21.	1.00000	1.007136	-.7136143E-02		1
22.	1.00000	1.007136	-.7136143E-02		1
23.	1.00000	1.007136	-.7136143E-02		1
24.	1.00000	1.007136	-.7136143E-02		1
25.	1.00000	1.007136	-.7136143E-02		1
26.	1.00000	1.007136	-.7136143E-02		1
27.	1.00000	1.007136	-.7136143E-02		1
28.	1.00000	1.007136	-.7136143E-02		1
29.	1.00000	1.007136	-.7136143E-02		1
30.	1.00000	1.007136	-.7136143E-02		1
31.	1.00000	1.007136	-.7136143E-02		1
32.	1.00000	1.007136	-.7136143E-02		1
33.	1.00000	1.007136	-.7136143E-02		1
34.	1.00000	1.007136	-.7136143E-02		1
35.	1.00000	1.007136	-.7136143E-02		1
36.	1.00000	1.007136	-.7136143E-02		1
37.	1.00000	1.007136	-.7136143E-02		1
38.	1.00000	1.007136	-.7136143E-02		1
39.	1.00000	1.007136	-.7136143E-02		1
40.	1.00000	1.007136	-.7136143E-02		1
41.	1.00000	1.007136	-.7136143E-02		1
42.	1.00000	1.007136	-.7136143E-02		1
43.	1.00000	1.007136	-.7136143E-02		1
44.	1.00000	1.007136	-.7136143E-02		1
45.	1.00000	1.007136	-.7136143E-02		1
46.	1.00000	1.007136	-.7136143E-02		1
47.	1.00000	1.007136	-.7136143E-02		1
48.	1.00000	1.007136	-.7136143E-02		1
49.	1.00000	1.007136	-.7136143E-02		1
50.	1.00000	1.007136	-.7136143E-02		1

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

FILE HARD (CREATION DATE = 10 SEP 78) WEAPON ACQUISITION REQUIREMENTS DATA

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***** MULTIPLE REGRESSION *****
OBSERVATION  Y VALUE  Y ESTIMATE  RESIDUAL  -2SD
53.  1.950000  1.402304  .4769570E-01  1
54.  1.720000  1.730720  -.1071951E-01  1
55.  1.190000  1.171173  .1002657E-01  1
56.  1.130000  1.170502  .5941761E-01  1
57.  1.190000  1.234667  -.4466654E-01  1
58.  1.190000  1.174392  .1560040E-01  1
59.  1.190000  1.236046  -.4600575E-01  1
60.  1.210000  1.220717  -.1071731E-01  1

```

NOTE - (*) INDICATES ESTIMATE CALCULATED WITH MEANS SUBSTITUTED
 R INDICATES POINT OUT OF RANGE OF PLOT

NUMBER OF CASES PLOTTED 60.
 NUMBER OF 2 S.D. OUTLIERS 3, OR 5.00 PERCENT OF THE TOTAL

VON NEUMANN RATIO 1.01109 DURBIN-WATSON TEST 1.70091

NUMBER OF POSITIVE RESIDUALS 10.
 NUMBER OF NEGATIVE RESIDUALS 42.
 NUMBER OF RUNS OF SIGNS 25.

EXPECTED NUMBER OF RUNS OF SIGNS 26.
 EXPECTED S.D. OF RUN DISTRIBUTION 3.21501
 UNIT NORMAL DEViate-
 Z0 (EXPECTED-OBSERVED)/S.D. -.21773
 PROBABILITY OF OBTAINING .GE. ABS(Z) .41302

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

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FILE WARD (CREATION DATE = 18 SEP 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. DERSS DESIGN WEONTASPEC STANDARDS

VARIABLE(S) ENTERED ON STEP NUMBER 3.. INTERFAC INTERFACE RECHTS

MULTIPLE R	.96551	ANALYSIS OF VARIANCE	OF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIF1
R SQUARE	.93220	REGRESSION	3.	20,77210	6,92405	256.66918	0
ADJUSTED R SQUARE	.92857	RESIDUAL	56.	1.51872	.02699		
STD DEVIATION	.16425	COEFF OF VARIABILITY	13.0 PCT				

----- VARIABLES IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFICANC
			SIGNIFICANCE	ELASTICITY					
WISREO	11.007833	.72332557	278.07105	.6495819	TIME	-.06132	.05077	.20759962	.058
OPCHAR	3.1917030	.42735239	55.779252	.9106232					
INTERFAC	-1.2371013	.31405403	15.516786	-.4739727					
(CONSTANT)	-12.070155	.67507615	363.46450	-1.12462					
			0						

----- VARIABLES NOT IN THE EQUATION -----

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

FILE NAME (CREATION DATE = 10 SEP 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE... DERSS DESIGN REQUISITE STANDARDS

VARIABLE(S) ENTERED ON STEP NUMBER 4.. TIME TIME FROM SPEC START

MULTIPLE R	.96564	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFIC
R SQUARE	.93246	REGRESSION	4.	20.77782	5.19446	189.82619	O
ADJUSTED R SQUARE	.92755	RESIDUAL	55.	1.50504	.02736		
STD DEVIATION	.14542	COEFF OF VARIABILITY	13.1 PCT				

----- VARIABLES IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	SIGNIFICANCE	BETA	ELASTICITY	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFICANCE
MISREQ	11.026769	.74080775	255.14691		.6462891						
OPCHAR	3.2850459	.03146395	55.193494		.943426						
INTERFAC	-1.2273088	.31701849	14.989501		.9145441						
TIME	-.13775009E-02	.30232994E-02	.2075962		2.04463						
(CONSTANT)	-12.017911	.68950434	345.58947		-.4702405						
					-1.11579						
					-.0173107						
					-.01432						

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
MISREQ	.74080775	15.973319	10.342958 , 13.310579
OPCHAR	.03146395	7.4292324	2.3407720 , 4.0701190
INTERFAC	.31701849	-3.8716380	-1.0627001 , -.5206156
TIME	.30232994E-02	-.05503101	-.74363363E-02 , .46013104E-02
CONSTANT	.68950434	-10.590037	-14.1997009 , -11.436114

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

FILE NAME (CREATION DATE = 10 SEP 70) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****
 DEPENDENT VARIABLE.. DERS3 DESIGN REQUISITE STANDARDS

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

MISREQ	.54820		
OPCHAR	-.05675	.10416	
INTERFAC	-.00003	-.12014	.10050
TIME	.00000	-.00009	-.00006 .00001

MISREQ OPCHAR INTERFAC TIME

OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SU	R
1.	1.000000	.9869227	-.1307271E-01		
2.	1.000000	.9869227	-.1307271E-01		
3.	1.000000	.9869227	-.1307271E-01		
4.	1.000000	.9869227	-.1307271E-01		
5.	1.000000	.9869227	-.1307271E-01		
6.	1.000000	.9869227	-.1307271E-01		
7.	1.070000	1.000316	-.1031595E-01		
8.	1.000000	.9810127	-.1050731E-01		
9.	1.000000	.9800352	-.1996402E-01		
10.	1.000000	.9772002	-.2271904E-01		
11.	1.000000	.9690151	-.13090409E-01		
12.	1.000000	.9676376	-.3236240E-01		
13.	1.000000	.9662601	-.3373991E-01		
14.	1.320000	1.301120	-.6112796E-01		
15.	1.060000	1.039377	-.2062207E-01		
16.	1.000000	.9800352	-.1996402E-01		
17.	1.000000	.9772002	-.2271904E-01		
18.	1.000000	.9690151	-.13090409E-01		
19.	1.000000	.9690151	-.13090409E-01		
20.	1.000000	.9662601	-.3373991E-01		
21.	2.200000	2.199515	-.0004891E-01		
22.	1.320000	1.3370373	-.5037294E-01		
23.	1.060000	1.036622	-.2337700E-01		
24.	1.000000	.9772002	-.2271904E-01		
25.	1.000000	.9690151	-.13090409E-01		
26.	1.000000	.9676376	-.3236240E-01		
27.	1.000000	.9662601	-.3373991E-01		
28.	4.240000	3.972051	-.2679490		
29.	1.320000	1.370100	-.5010709E-01		
30.	1.060000	1.020357	-.3164294E-01		
31.	1.000000	.9690151	-.13090409E-01		
32.	1.000000	.9676376	-.3236240E-01		
33.	1.000000	2.490335	-.3373991E-01		
34.	1.000000	2.490335	-.0303340		
35.	1.000000	.9676376	-.3236240E-01		
36.	1.000000	.9662601	-.3373991E-01		
37.	1.060000	1.026980	-.3302045E-01		
38.	1.320000	1.308730	-.4073030E-01		
39.	4.240000	3.970679	-.2693265		
40.	1.760000	1.521136	-.0306601		
41.	1.000000	1.025602	-.7439790E-01		
42.	1.060000	1.025602	-.3439790E-01		
43.	1.320000	1.367353	-.4735207E-01		
44.	1.040000	.9662601	-.3373991E-01		
45.	1.170000	1.320222	-.1502215		
46.	1.320000	1.365975	-.4597536E-01		
47.	1.000000	.9660026	-.3511742E-01		
48.	1.400000	1.690075	-.2100749		
49.	1.170000	1.310000	-.1000000		
50.	1.000000	.9635051	-.3649493E-01		

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

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FILE HAND (CREATION DATE = 18 SEP 78) WEAPON ACQUISITION REQUIREMENTS DATA

OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SD	0.0
53.	1.00000	1.000565	-.200565		
54.	1.00000	1.951201	-.512011		
55.	1.00000	1.230259	-.170259		
56.	1.17000	1.311956	-.141956		
57.	1.00000	1.236091	-.236091		
58.	1.00000	1.224617	-.164617		
59.	1.00000	1.232750	-.232750		
60.	1.53000	1.330933	-.190933		

NOTE - (.) INDICATES ESTIMATE CALCULATED WITH MEANS SUBSTITUTED
R INDICATES POINT OUT OF RANGE OF PLOT

NUMBER OF CASES PLOTTED	60.	
NUMBER OF 2 S.D. OUTLIERS	2.	3.33 PERCENT OF THE TOTAL
VON NEUMANN RATIO	1.03172	DURRIN-WATSON TEST 1.00119
NUMBER OF POSITIVE RESIDUALS	42.	
NUMBER OF NEGATIVE RESIDUALS	10.	
NUMBER OF RUNS OF SIGNS	23.	
EXPECTED NUMBER OF RUNS OF SIGNS	26.	
EXPECTED S.D. OF RUN DISTRIBUTION	3.21501	
UNIT NORMAL DEViate		
Z=(EXPECTED-OBSERVED)/S.D.	-.03901	
PROBABILITY OF OBTAINING .05. ABS(2)	.20051	

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. INTERFAC INTERFACE RLMTS

MEAN RESPONSE 1.14017 STD. DEV. .23595

VARIABLE(S) ENTERED ON STEP NUMBER 1.. OPCHAR OPERATIONAL CHARACTERISTICS

MULTIPLE R	.95727	ANALYSIS OF VARIANCE	OF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFIC.
R SQUARE	.91637	REGRESSION	1.	2.99736	2.99736	635.54797	O
ADJUSTED R SQUARE	.91493	RESIDUAL	50.	.27354	.00472		
STD DEVIATION	.06667	COEFF OF VARIABILITY	6.0 PCT				

----- VARIABLES NOT IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFICANC.
OPCHAR	1.2054072	.50991007E-01	635.54797	.9572732	DERSS	-.22046	.41493	2.9110940	
(CONSTANT)	-.29265023	.57035994E-01	25.603619	1.25400	MISREQ	-.00865	.77513	.42615406	
			.000		TIME	.06775	.00206	.26267037	
								.010	

***** DESIGN RECHT-SPEC STANDARDS *****

VARIABLE(S) ENTERED ON STEP NUMBER 2.. DERSS DESIGN RECHT-SPEC STANDARDS

MULTIPLE R	.95939	ANALYSIS OF VARIANCE	OF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFIC.
R SQUARE	.92044	REGRESSION	2.	3.01065	1.50533	329.70494	O
ADJUSTED R SQUARE	.91764	RESIDUAL	57.	.26024	.00457		
STD DEVIATION	.06757	COEFF OF VARIABILITY	5.9 PCT				

----- VARIABLES NOT IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFICANC
OPCHAR	1.3071403	.77006713E-01	317.10964	1.0129740	MISREQ	.42075	.16175	12.005947	
DERSS	-.37919916E-01	.22221010E-01	2.9110940	1.35013	TIME	.02533	.00043	.35905902	
(CONSTANT)	-.35070255	.60022695E-01	27.164742	-.04171				.050	

MISSION OF WEAPON ACQUISITION REQUIREMENTS

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FILE NAME (CREATION DATE = 10 SEP 78) WEAPON ACQUISITION REQUIREMENTS DATA

DEPENDENT VARIABLE INTERFAC INTERFACE REUNTS MULTIPLE REGRESSION

VARIABLE(S) ENTERED ON STEP NUMBER 3.. MISREQ MISSION REQUIREMENTS

MULTIPLE R	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI
R SQUARE	REGRESSION	3.	3.05672	1.01891	266.41396	Q
ADJUSTED R SQUARE	RESIDUAL	56.	.21017	.00382		
STD DEVIATION	COEFF OF VARIABILITY	5.4 PCI				

VARIABLES IN THE EQUATION

VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFICANC
OPCHAR	1.5677667	.00259052E-01	115.52698	1.1679884	TIME	.03116	.00039	.53470941	.018
DERSS	-.17538302	.40523330E-01	15.516706	1.53094					
MISREQ	2.0691951	.59610498	12.045947	-.0577620					
(CONSTANT)	-2.0722434	.61221103	16.307224	-.19292					
			.001	.2950940					
			.000	1.01569					

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

IN SEP 78 PAGE 34

FILE WARD (CREATION DATE = 10 SEP 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. INTERFAC INTERFACE RIGHTS

VARIABLE(S) ENTERED ON STEP NUMBER 4.. TIME TIME FROM SPEC START

MULTIPLE R	.96674	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI-
R SQUARE	.93459	REGRESSION	4.	3.85693	.76423		O
ADJUSTED R SQUARE	.92983	RESIDUAL	55.	.21397	.00389		
STD DEVIATION	.06237	COEFF OF VARIABILITY	5.4 PCT				

----- VARIABLES IN THE EQUATION -----

----- VARIABLES NOT IN THE EQUATION -----

VARIABLE	U	STD ERROR B	F	BETA	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFICANC
			SIGNIFICANCE	ELASTICITY					
OPCHAR	1.5613187	.93291888E-01	200.09000	1.1626727					
DERSS	-.17449250	.45069425E-01	14.909501	1.52014					
MISREQ	2.0701600	.60130206	11.652901	-.4554374					
TIME	.26396471E-03	.11415298E-02	.001	.2952327					
(CONSTANT)	-2.4705794	.61749330	.53478941E-01	1.01654					
			16.007851	.0006500					
			.000	.00302					

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
OPCHAR	1.5613187	.93291888E-01	16.735900	1.3743512 , 1.7482182
DERSS	-.17449250	.45069425E-01	-3.8710300	-.26401365 , -.08471351E-01
MISREQ	2.0701600	.60130206	3.4420043	.06513018 , 3.2752059
TIME	.26396471E-03	.11415298E-02	.23123705	-.20237105E-02 , .25516400E-02
CONSTANT	-2.4705794	.61749330	-4.0009012	-3.7000630 , -1.2338950

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS
FILE WARD (CREATION DATE = 10 SEP 78) WEAPON ACQUISITION REQUIREMENTS DATA
***** MULTIPLE REGRESSION *****
DEPENDENT VARIABLE.. INTERFAC INTERFACE REGMTS

10 SEP 78 PAGE 35

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

DERSS	.00203		
MISREQ	-.02800	.36157	
OPCHAR	-.00333	.03144	.00070
TIME	.00000	.00000	-.00003
			.00000

DERSS MISREQ OPCHAR TIME

OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SD	W.W
1.	1.000000	.9864068	.11359310E-01		1
2.	1.000000	.9864068	.11359310E-01		1
3.	1.000000	.9864068	.11359310E-01		1
4.	1.000000	.9864068	.11359310E-01		1
5.	1.000000	.9864068	.11359310E-01		1
6.	1.000000	.9864068	.11359310E-01		1
7.	1.050000	1.0533114	-.3313740E-02		1
8.	1.000000	.9874027	.1253732E-01		1
9.	1.000000	.9877266	.1227335E-01		1
10.	1.000000	.9882546	.1174541E-01		1
11.	1.000000	.9890104	.1016164E-01		1
12.	1.000000	.9901023	.9097672E-02		1
13.	1.000000	.9903603	.9633700E-02		1
14.	1.300000	1.3066094	-.6603612E-02		1
15.	1.000000	1.024096	.5903504E-02		1
16.	1.000000	.9877266	.1227335E-01		1
17.	1.000000	.9882546	.1174541E-01		1
18.	1.000000	.9890104	.1016164E-01		1
19.	1.000000	.9898104	.1016164E-01		1
20.	1.000000	.9903603	.9633700E-02		1
21.	1.310000	1.565568	-.2355595	R	1
22.	1.300000	1.107132	-.7131541E-02		1
23.	1.030000	1.024624	.5375654E-02		1
24.	1.000000	.9862546	.1174541E-01		1
25.	1.000000	.9898104	.1016164E-01		1
26.	1.000000	.9901023	.9697672E-02		1
27.	1.000000	.9903603	.9633700E-02		1
28.	1.000000	1.666158	.1364167E-01		1
29.	1.300000	1.300715	-.0715329E-02		1
30.	1.000000	1.026208	.3791666E-02		1
31.	1.000000	.9898104	.1016164E-01		1
32.	1.000000	.9901023	.9697672E-02		1
33.	1.000000	.9903603	.9633700E-02		1
34.	1.420000	1.461157	-.0175723E-01		1
35.	1.000000	.9901023	.9697672E-02		1
36.	1.000000	.9903603	.9633700E-02		1
37.	1.030000	1.026472	.3527901E-02		1
38.	1.300000	1.300979	-.0979294E-02		1
39.	1.000000	1.666622	.1337771E-01		1
40.	1.700000	1.497689	.2021106		1
41.	1.000000	1.017756	.1024364E-01		1
42.	1.030000	1.026736	.3263937E-02		1
43.	1.300000	1.309243	-.9243254E-02		1
44.	1.000000	.9903603	.9633700E-02		1
45.	1.050000	1.163917	-.1139169		1
46.	1.300000	1.309507	-.9507223E-02		1
47.	1.000000	.9903603	.9697672E-02		1
48.	1.500000	1.609720	-.2972763E-01		1
49.	1.050000	1.164201	-.1142009		1
50.	1.000000	.9700942	.9105770E-02		1

R

10 SEP 78 PAGE 10

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

FILE WARD (CREATION DATE = 10 SEP 78) WEAPON ACQUISITION REQUIREMENTS DATA

```

***** MULTIPLE REGRESSION *****
OBSERVATION  Y VALUE  Y ESTIMATE  RESIDUAL  -2SD
534  1.508000  1.610703  -.102703  .09
54  2.070000  1.959314  -.110655  .11
55  1.270000  1.270394  -.039394  .11
56  1.050000  1.165211  -.115211  .11
57  1.260000  1.206950  -.046950  .11
58  1.270000  1.280241  -.010241  .11
59  1.260000  1.287746  -.027746  .11
60  1.230000  1.230776  -.040776  .11

```

NOTE - (*) INDICATES ESTIMATE CALCULATED WITH MEANS SUBSTITUTED
 R INDICATES POINT OUT OF RANGE OF PLOT

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NUMBER OF CASES PLOTTED  60
NUMBER OF 2 S.D. OUTLIERS  2, OR  3.33 PERCENT OF THE TOTAL

VON NEUMANN RATIO  2.00100  DURBIN-WATSON TEST  1.96772

NUMBER OF POSITIVE RESIDUALS  41.
NUMBER OF NEGATIVE RESIDUALS  19.
NUMBER OF RUNS OF SIGNS  26.

EXPECTED NUMBER OF RUNS OF SIGNS  27.
EXPECTED S.D. OF RUN DISTRIBUTION  3.31964
UNIT NORMAL DEVIATE  -.10070
Z=(EXPECTED-OBSERVED)/S.D.  .44002
PROBABILITY OF OBTAINING .GE. ABS(Z)

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APPENDIX ELEVEN
COMPUTER RUN WITH 60 TRANSFORMED DATA POINTS
AND TWO INDEPENDENT VARIABLES COMBINED

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

31 AUG 78 PAGE 2

FILE WARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

VARIABLE	MEAN	STANDARD DEV	CASES
MISREQ	1.8075	.0136	60
DERSS	1.2630	.0196	60
OPINT	2.2698	.0065	60
TIME	13.1333	7.7229	60

CORRELATION COEFFICIENTS.

A VALUE OF 99.0000 IS PRINTED
IF A COEFFICIENT CANNOT BE COMPUTED.

DERSS	.06721	
OPINT	.06623	.73010
TIME	.01930	.10226
		.39888

MISREQ	DERSS	OPINT
--------	-------	-------

31 AUG 78 PAGE 3

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

FILE WARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. OPINT

MEAN RESPONSE 2.26000 STD. DEV. .48600

VARIABLE(S) ENTERED ON STEP NUMBER 1.. TIME TIME FROM SPEC START

MULTIPLE R	.34800	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFIC
R SQUARE	.12116	REGRESSION	1.	1.10107	1.10107	7.99691	0
ADJUSTED R SQUARE	.10601	RESIDUAL	50.	8.56707	.14771		
STD DEVIATION	.30433	COEFF OF VARIABILITY	16.9 PCT				

----- VARIABLES IN THE EQUATION -----				----- VARIABLES NOT IN THE EQUATION -----			
VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL TOLERANCE	F SIGNIFICANC
TIME	.10328320E-01	.64780291E-02	7.9969089	.3480790			
(CONSTANT)	2.2203931	.98090091E-01	424.80000	.10600			

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
TIME	.10328320E-01	.64780291E-02	2.0277215	.53515300E-02, .31209110E-01
CONSTANT	2.2203931	.98090091E-01	20.593222	1.0312277, 2.2255500

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

TIME	.80400
TIME	

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. MISREQ MISSION REQUIREMENTS

MEAN RESPONSE 1.00750 STD. DEV. .03350

VARIABLE(S) ENTERED ON STEP NUMBER 1.. DERSS DESIGN REQHT*SPEC STANDARDS

MULTIPLE R	.66721	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFIC
R SQUARE	.75205	REGRESSION	1.	.05003	.05003	175.92126	O
ADJUSTED R SQUARE	.74778	RESIDUAL	56.	.01649	.00028		
STD DEVIATION	.01606	COEFF OF VARIABILITY	1.7 PCT				

----- VARIABLES IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFICANC
DERSS	.47383953E-01	.35724991E-02	175.92126	.0672101	OPINT	-.49123	.46666	10.129574	.000
(CONSTANT)	.94765407	.50090408E-02	35780.030	.05940					

***** MULTIPLE REGRESSION *****

VARIABLE(S) ENTERED ON STEP NUMBER 2.. OPINT

MULTIPLE R	.90165	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFIC
R SQUARE	.81104	REGRESSION	2.	.05401	.02701	123.00389	O
ADJUSTED R SQUARE	.80529	RESIDUAL	57.	.01251	.00022		
STD DEVIATION	.01402	COEFF OF VARIABILITY	1.5 PCT				

----- VARIABLES IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	BETA	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFICANC
DERSS	.61672129E-01	.45949408E-02	180.14266	1.1287080					
OPINT	-.29580008E-01	.69471271E-02	10.129574	.07731					
			.000	-.06662					

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS
 FILE WARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA
 MULTIPLE REGRESSION
 DEPENDENT VARIABLE.. MISREQ MISSION REQUIREMENTS

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
DERSS	.61672129E-01	.45949004E-02	13.421723	.52478003E-01, .70873355E-01
OPINT	-.29581060E-01	.69471271E-02	-4.2578018	-.43491442E-01, -.15666670E-01
CONSTANT	.99672526	.12336884E-01	80.792825	.97282123, 1.0210293

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

OPINT	-.24015
DERSS	-.00002 .00002
OPINT	DERSS

OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SD	P. H
1.	1.10000	.992373	.7627340E-03		1.
2.	1.10000	.992373	.7627340E-03		1.
3.	1.10000	.992373	.7627340E-03		1.
4.	1.10000	.992373	.7627340E-03		1.
5.	1.10000	.992373	.7627340E-03		1.
6.	1.10000	.992373	.7627340E-03		1.
7.	1.10000	.992373	.7627340E-03		1.
8.	1.10000	.992373	.7627340E-03		1.
9.	1.10000	.992373	.7627340E-03		1.
10.	1.10000	.992373	.7627340E-03		1.
11.	1.10000	.992373	.7627340E-03		1.
12.	1.10000	.992373	.7627340E-03		1.
13.	1.10000	.992373	.7627340E-03		1.
14.	1.10000	.992373	.7627340E-03		1.
15.	1.10000	.992373	.7627340E-03		1.
16.	1.10000	.992373	.7627340E-03		1.
17.	1.10000	.992373	.7627340E-03		1.
18.	1.10000	.992373	.7627340E-03		1.
19.	1.10000	.992373	.7627340E-03		1.
20.	1.10000	.992373	.7627340E-03		1.
21.	1.10000	.992373	.7627340E-03		1.
22.	1.10000	.992373	.7627340E-03		1.
23.	1.10000	.992373	.7627340E-03		1.
24.	1.10000	.992373	.7627340E-03		1.
25.	1.10000	.992373	.7627340E-03		1.
26.	1.10000	.992373	.7627340E-03		1.
27.	1.10000	.992373	.7627340E-03		1.
28.	1.10000	.992373	.7627340E-03		1.
29.	1.10000	.992373	.7627340E-03		1.
30.	1.10000	.992373	.7627340E-03		1.
31.	1.10000	.992373	.7627340E-03		1.
32.	1.10000	.992373	.7627340E-03		1.
33.	1.10000	.992373	.7627340E-03		1.
34.	1.10000	.992373	.7627340E-03		1.
35.	1.10000	.992373	.7627340E-03		1.
36.	1.10000	.992373	.7627340E-03		1.
37.	1.10000	.992373	.7627340E-03		1.
38.	1.10000	.992373	.7627340E-03		1.
39.	1.10000	.992373	.7627340E-03		1.
40.	1.10000	.992373	.7627340E-03		1.
41.	1.10000	.992373	.7627340E-03		1.
42.	1.10000	.992373	.7627340E-03		1.
43.	1.10000	.992373	.7627340E-03		1.
44.	1.10000	.992373	.7627340E-03		1.
45.	1.10000	.992373	.7627340E-03		1.
46.	1.10000	.992373	.7627340E-03		1.
47.	1.10000	.992373	.7627340E-03		1.
48.	1.10000	.992373	.7627340E-03		1.
49.	1.10000	.992373	.7627340E-03		1.
50.	1.10000	.992373	.7627340E-03		1.
51.	1.10000	.992373	.7627340E-03		1.
52.	1.10000	.992373	.7627340E-03		1.

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

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FILE WARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SD	4.0
53.	1.00000	.9983724	.1627571E-02		1.
54.	1.00000	1.001794	-.1791076E-02		1.
55.	1.00000	.9993308	.1066923E-01		1.
56.	1.00000	1.004397	-.4397117E-02		1.
57.	1.00000	1.015529	-.1552006E-01		1.
58.	1.00000	.9993308	.1066923E-01		1.
59.	1.00000	1.015529	-.1552006E-01		1.
60.	1.00000	1.016906	-.169027E-01		1.

NOTE - (+) INDICATES ESTIMATE CALCULATED WITH MEANS SUBSTITUTED
R INDICATES POINT OUT OF RANGE OF PLOT

NUMBER OF CASES PLOTTED	60.		
NUMBER OF 2 S.D. OUTLIERS	2.	OR	3.33 PERCENT OF THE TOTAL
VON NEUMANN RATIO	1.98735		DURBIN-WATSON TEST 1.95823
NUMBER OF POSITIVE RESIDUALS	37.		
NUMBER OF NEGATIVE RESIDUALS	23.		
NUMBER OF RUNS OF SIGNS	24.		
EXPECTED NUMBER OF RUNS OF SIGNS	29.		
EXPECTED S.D. OF RUN DISTRIBUTION	3.62735		
UNIT NORMAL DEViate			
Z = (EXPECTED-OBSERVED)/S.D.	-1.34166		
PROBABILITY OF OBTAINING .GE. ABS(Z)	.08985		

FILE NAME (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

DEPENDENT VARIABLE.. UPINT

MEAN RESPONSE 2.26900 STD. DEV. .40640

VARIABLE(S) ENTERED ON STEP NUMBER 1.. DERSS DESIGN REQNT*SPEC STANDARDS

MULTIPLE R	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFI.
R SQUARE	REGRESSION	1.	5.19900	5.19900	66.20765	0
ADJUSTED R SQUARE	RESIDUAL	50.	4.54986	.07843		
STD DEVIATION	COEFF OF VARIABILITY	12.3 PCT				

VARIABLES IN THE EQUATION				VARIABLES NOT IN THE EQUATION			
VARIABLE	B	STD ERROR B	F SIGNIFICANCE	VARIABLE	PARTIAL TOLERANCE	F SIGNIFICANCE	
DERSS	.40303485	.59320234E-01	66.207654	MISREQ	-.49123	.24795	
(CONSTANT)	1.4509200	.03190197E-01	397.56249			10.129574	
			.000			.000	

VARIABLE(S) ENTERED ON STEP NUMBER 2.. MISREQ MISSION REQUIREMENTS

MULTIPLE R	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFIC
R SQUARE	REGRESSION	2.	6.29682	3.14841	51.99723	0
ADJUSTED R SQUARE	RESIDUAL	57.	3.45132	.06055		
STD DEVIATION	COEFF OF VARIABILITY	10.8 PCT				

VARIABLES IN THE EQUATION				VARIABLES NOT IN THE EQUATION			
VARIABLE	B	STD ERROR B	F SIGNIFICANCE	VARIABLE	PARTIAL TOLERANCE	F SIGNIFICANCE	
DERSS	.06950693	.10460653	68.999255				
MISREQ	-8.1570060	1.9159485	10.129574				
			.000				

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

31 AUG 78 FALF 11

FILE WARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****
 DEPENDENT VARIABLE.. OPINT

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
DERSS	.86958693	.10448653	8.3065790	.65995577 , 1.0792181
MISREO	-8.1578868	1.9159485	-4.2576830	-11.994507 , -4.3212653
CONSTANT	9.3897818	1.6171274	5.1673760	5.7518970 , 13.028517

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

MISREO	3.67486	
DERSS	-.17394	.01896
MISREO		DERSS

AD-A107 875

AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH
A STUDY OF RESEARCH AND DEVELOPMENT CONTRACT REQUIREMENTS AND T--ETC(U)
MAY 79 R 6 BLACKLEDGE
AFIT-CI-79-214D

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UNCLASSIFIED

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4 OF 4

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OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SD	0.0
1.	2.00000	2.101403	-.1014028	.	1
2.	2.00000	2.101403	-.1014028	.	1
3.	2.00000	2.101403	-.1014028	.	1
4.	2.00000	2.101403	-.1014028	.	1
5.	2.00000	2.101403	-.1014028	.	1
6.	2.00000	2.101403	-.1014028	.	1
7.	2.00000	2.102554	-.1025537E-01	.	1
8.	2.00000	2.101403	-.1014028	.	1
9.	2.00000	2.101403	-.1014028	.	1
10.	2.00000	2.101403	-.1014028	.	1
11.	2.00000	2.101403	-.1014028	.	1
12.	2.00000	2.101403	-.1014028	.	1
13.	2.00000	2.101403	-.1014028	.	1
14.	2.00000	2.101403	-.1014028	.	1
15.	2.00000	2.153658	-.102494	.	1
16.	2.00000	2.101403	-.1014028	.	1
17.	2.00000	2.101403	-.1014028	.	1
18.	2.00000	2.101403	-.1014028	.	1
19.	2.00000	2.101403	-.1014028	.	1
20.	2.00000	2.101403	-.1014028	.	1
21.	2.00000	3.214554	-.1045591	.	1
22.	2.00000	2.379751	-.102494	.	1
23.	2.00000	2.153658	-.1014028	.	1
24.	2.00000	2.101403	-.1014028	.	1
25.	2.00000	2.101403	-.1014028	.	1
26.	2.00000	2.101403	-.1014028	.	1
27.	2.00000	2.101403	-.1014028	.	1
28.	3.250000	3.532104	-.1014028	.	1
29.	2.50000	2.379751	-.102494	.	1
30.	2.00000	2.153658	-.1014028	.	1
31.	2.00000	2.101403	-.1014028	.	1
32.	2.00000	2.101403	-.1014028	.	1
33.	2.00000	2.101403	-.1014028	.	1
34.	2.00000	1.770493	-.1019571	.	1
35.	2.00000	2.101403	-.1014028	.	1
36.	2.00000	2.101403	-.1014028	.	1
37.	2.00000	2.153658	-.1014028	.	1
38.	2.50000	2.379751	-.102494	.	1
39.	3.250000	3.532104	-.1014028	.	1
40.	3.100000	2.762369	-.102494	.	1
41.	2.00000	2.100491	-.1204915	.	1
42.	2.00000	2.153658	-.1014028	.	1
43.	2.00000	2.379751	-.102494	.	1
44.	2.00000	2.101403	-.1014028	.	1
45.	2.100000	2.249313	-.1012561E-01	.	1
46.	2.500000	2.379751	-.102494	.	1
47.	2.000000	2.101403	-.1014028	.	1
48.	3.000000	2.510885	-.101155	.	1
49.	2.100000	2.249313	-.1012561E-01	.	1
50.	2.000000	2.101403	-.1014028	.	1

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MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

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FILE WARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

***** MULTIPLE REGRESSION *****									
OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SD	0.0				
53.	3.43MMW	2.510085	.511155		1				R
54.	3.7QUUW	2.664111	.905000		1				R
55.	2.4QUUW	2.153658	.306342		1				
56.	2.10MMW	2.279313	-.093125	-.01	1				
57.	2.45MMW	2.510085	-.060451	-.01	1				
58.	2.46MMW	2.153658	.306342		1				
59.	2.45MMW	2.510085	-.060451	-.01	1				
60.	2.46MMW	2.562364	-.122369		1				

NOTE - (*) INDICATES ESTIMATE CALCULATED WITH MEANS SUBSTITUTED
 R INDICATES POINT OUT OF RANGE OF PLOT

NUMBER OF CASES PLOTTED 60.
 NUMBER OF 2 S.D. OUTLIERS 4. OR 6.67 PERCENT OF THE TOTAL
 VON NEUMANN RATIO 1.09308 CURRIN-WATSON TEST 1.06232
 NUMBER OF POSITIVE RESIDUALS 19.
 NUMBER OF NEGATIVE RESIDUALS 40.
 NUMBER OF RUNS OF SIGNS 25.
 EXPECTED NUMBER OF RUNS OF SIGNS 22.
 EXPECTED S.D. OF RUN DISTRIBUTION 2.72005
 UNIT NORMAL DEVIATE-
 Z=(EXPECTED-OBSERVED)/S.D. 1.11156
 PROBABILITY OF OBTAINING .GE. ABS(Z) .13316

***** MULTIPLE REGRESSION *****

DEPENDENT VARIABLE.. DEMSS DESIGN REQUISITE STANDARDS

MEAN RESPONSE 1.26308 STD. DEV. .61955

VARIABLE(S) ENTERED ON STEP NUMBER 1.. MISREQ MISSION REQUIREMENTS

MULTIPLE R	.86721	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFICANCE
R SQUARE	.75205	REGRESSION	1.	16.75798	16.75798	175.92126	.0
ADJUSTED R SQUARE	.79778	RESIDUAL	56.	5.52496	.09526		
STD DEVIATION	.38864	COEFF OF VARIABILITY	24.4 PCT				

VARIABLES IN THE EQUATION				VARIABLES NOT IN THE EQUATION			
VARIABLE	B	STD ERROR B	F SIGNIFICANCE	BETA ELASTICITY	VARIABLE	PARTIAL TOLERANCE	F SIGNIFICANCE
MISREQ	15.871877	1.1966253	175.92126	.8672101	UPINT	.74081	.70261
(CONSTANT)	-14.727513	1.2662502	149.86508	12.66074			68.999255

VARIABLE(S) ENTERED ON STEP NUMBER 2.. OPINT

MULTIPLE R	.94225	ANALYSIS OF VARIANCE	DF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFICANCE
R SQUARE	.8783	REGRESSION	2.	19.70306	9.85153	225.58539	.0
ADJUSTED R SQUARE	.80198	RESIDUAL	57.	2.49998	.04385		
STD DEVIATION	.20940	COEFF OF VARIABILITY	16.6 PCT				

VARIABLES IN THE EQUATION				VARIABLES NOT IN THE EQUATION			
VARIABLE	B	STD ERROR B	F SIGNIFICANCE	BETA ELASTICITY	VARIABLE	PARTIAL TOLERANCE	F SIGNIFICANCE
MISREQ	12.317369	.91771886	168.14266	.671053			
OPINT	.62974310	.750125701	68.999255	.9165229			
(CONSTANT)	-12.575636	.85843883	214.60968	1.11134			

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

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FILE NAME CREATION DATE = 31 AUG 78 WEAPON ACQUISITION REQUIREMENTS DATA

***** M U L T I P L E R E G R E S S I O N *****

DEPENDENT VARIABLE.. DLSS DESIGN HEIGHT SPEC STANDARDS

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	95.0 PCT CONFIDENCE INTERVAL
HSHLO	12.317369	.91771886	13.421723	10.479668 , 14.155869
OPINT	.62978319	.75812570E-01	8.3865798	.47793105 , .78155516
CONSTANT	-12.575636	.85843883	-14.649562	-14.294614 , -10.856658

VARIANCE/COVARIANCE MATRIX OF THE UNNORMALIZED REGRESSION COEFFICIENTS.

HSHLO	.84221
OPINT	-.03248 .60575
HSHLO	OPINT

OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SD	R
1.	1.00000	1.001219	-.121009E-02		
2.	1.00000	1.001219	-.121009E-02		
3.	1.00000	1.001219	-.121009E-02		
4.	1.00120	1.001219	-.121009E-02		
5.	1.00000	1.001219	-.121009E-02		
6.	1.00000	1.001219	-.121009E-02		
7.	1.00000	1.004193	.500608E-02		
8.	1.00000	1.001219	-.121009E-02		
9.	1.00000	1.001219	-.121009E-02		
10.	1.00000	1.001219	-.121009E-02		
11.	1.00000	1.001219	-.121009E-02		
12.	1.00000	1.001219	-.121009E-02		
13.	1.00000	1.001219	-.121009E-02		
14.	1.32000	1.301200	-.212001E-01		
15.	1.00000	1.00000	.2099657E-01		
16.	1.00000	1.001219	-.121009E-02		
17.	1.00000	1.001219	-.121009E-02		
18.	1.00000	1.001219	-.121009E-02		
19.	1.00000	1.001219	-.121009E-02		
20.	1.00000	1.001219	-.121009E-02		
21.	2.20000	1.511311	.7006092		
22.	1.32000	1.301200	-.212001E-01		
23.	1.00000	1.00000	.2099657E-01		
24.	1.00000	1.001219	-.121009E-02		
25.	1.00000	1.001219	-.121009E-02		
26.	1.00000	1.001219	-.121009E-02		
27.	1.00000	1.001219	-.121009E-02		
28.	4.20000	3.002350	.3576496		
29.	1.32000	1.301200	-.212001E-01		
30.	1.00000	1.00000	.2099657E-01		
31.	1.00000	1.001219	-.121009E-02		
32.	1.00000	1.001219	-.121009E-02		
33.	1.00000	1.001219	-.121009E-02		
34.	1.00000	2.765062	-1.35462		
35.	1.00000	1.001219	-.121009E-02		
36.	1.00000	1.001219	-.121009E-02		
37.	1.00000	1.00000	.2099657E-01		
38.	1.32000	1.301200	-.212001E-01		
39.	4.20000	3.002350	.3576496		
40.	1.70000	1.750613	.930600E-02		
41.	1.00000	1.00000	.6099657E-01		
42.	1.00000	1.00000	.2099657E-01		
43.	1.32000	1.301200	-.212001E-01		
44.	1.00000	1.001219	-.121009E-02		
45.	1.17000	1.114573	.5502740E-01		
46.	1.32000	1.301200	-.212001E-01		
47.	1.00000	1.001219	-.121009E-02		
48.	1.00000	1.690500	-.1690502		
49.	1.17000	1.114573	.5502740E-01		
50.	1.00000	1.001219	-.121009E-02		
51.	1.00000	1.290901	-.2309007		
52.	1.17000	1.114573	.5502740E-01		

MULTIPLE REGRESSION OF WEAPON ACQUISITION REQUIREMENTS

31 AUG 78 PAGE 19

FILE HARD (CREATION DATE = 31 AUG 78) WEAPON ACQUISITION REQUIREMENTS DATA

OBSERVATION	Y VALUE	Y ESTIMATE	RESIDUAL	-2SD	0.0
53.	1.400000	1.649054	-.1690542		1
54.	1.940000	2.120459	-.2204590		1
55.	1.060000	1.290901	-.2309007		1
56.	1.170000	1.114573	.5542740E-01		1
57.	1.400000	1.204643	.1953968		1
58.	1.060000	1.290901	-.2309007		1
59.	1.400000	1.204643	.1953968		1
60.	1.530000	1.276366	.2516942		1

NOTE - (-) INDICATES ESTIMATE CALCULATED WITH MEANS SUBSTITUTED
R INDICATES POINT OUT OF RANGE OF PLOT

NUMBER OF CASES PLOTTED	60.	
NUMBER OF 2 S.D. OUTLIERS	2.	OR 3.33 PERCENT OF THE TOTAL
VON NEUMANN RATIO	2.01724	SHIRIN-WATSON TEST 1.98362
NUMBER OF POSITIVE RESIDUALS	10.	
NUMBER OF NEGATIVE RESIDUALS	42.	
NUMBER OF RUNS OF SIGNS	26.	
EXPECTED NUMBER OF RUNS OF SIGNS	26.	
EXPECTED S.D. OF RUN DISTRIBUTION	3.21501	
UNIT NORMAL DEViate-		
Z=(EXPECTED-OBSERVED)/S.D.	.09331	
PROBABILITY OF OBTAINING .5E. ABS(Z)	.46203	

APPENDIX TWELVE

COMPUTER RUN WITH 60 TRANSFORMED DATA POINTS AND
MISSION REQUIREMENTS TREATED AS TIME DEPENDENT

00 JUL 70 PAGE 2

UNIT RECORDS OF WEAPON ACQUISITION REQUIREMENTS

FILE NAME OPERATION DATE = 04 JUL 70 WEAPON ACQUISITION REQUIREMENTS DATA

.....MULTIPLE DEFENSES.....

VARIABLE	MEAN	STANDARD DEV	CASES
WEAPON	1.0000	.0000	60
OPERATION	1.0000	.0000	60
DEFENSE	1.0000	.0000	60
INTERFAC	1.0000	.0000	60
TIME	1.0000	.0000	60

CORRELATION COEFFICIENTS:

A VALUE OF .000000 IS PRINTED
IF A CORRELATION COEFFICIENT IS COMPUTED.

WEAPON	.0000	DEFENSE	.0000
OPERATION	.0000	INTERFAC	.0000
DEFENSE	.0000	TIME	.0000
INTERFAC	.0000		
TIME	.0000		

[illegible][illegible]

CONFIDENTIAL VARIATION - MISSED - MISSED - MISSED

[illegible]

Wavelength (nm)	Extinction Coefficient (M ⁻¹ cm ⁻¹)	Time (min)	Temperature (°C)
210	1000	100	25
220	1000	100	25
230	1000	100	25
240	1000	100	25
250	1000	100	25
260	1000	100	25
270	1000	100	25
280	1000	100	25
290	1000	100	25
300	1000	100	25
310	1000	100	25
320	1000	100	25
330	1000	100	25
340	1000	100	25
350	1000	100	25
360	1000	100	25
370	1000	100	25
380	1000	100	25
390	1000	100	25
400	1000	100	25
410	1000	100	25
420	1000	100	25
430	1000	100	25
440	1000	100	25
450	1000	100	25
460	1000	100	25
470	1000	100	25
480	1000	100	25
490	1000	100	25
500	1000	100	25
510	1000	100	25
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630	1000	100	25
640	1000	100	25
650	1000	100	25
660	1000	100	25
670	1000	100	25
680	1000	100	25
690	1000	100	25
700	1000	100	25
710	1000	100	25
720	1000	100	25
730	1000	100	25
740	1000	100	25
750	1000	100	25
760	1000	100	25
770	1000	100	25
780	1000	100	25
790	1000	100	25
800	1000	100	25
810	1000	100	25
820	1000	100	25
830	1000	100	25
840	1000	100	25
850	1000	100	25
860	1000	100	25
870	1000	100	25
880	1000	100	25
890	1000	100	25
900	1000	100	25
910	1000	100	25
920	1000	100	25
930	1000	100	25
940	1000	100	25
950	1000	100	25
960	1000	100	25
970	1000	100	25
980	1000	100	25
990	1000	100	25
1000	1000	100	25

[illegible]

----- VARIABLES IN THE FORMATION

[illegible]

JUL	.954683245-05	.373636047-06	.14007032-01	.0150769
COUNTS ANT	1.0004401	.588039044-01	7.1018787	.000000
			000	

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	n	STD ERROR	t	95.0% PCT CONFIDENCE INTERVAL
1111	20419247	.3736340	12.67184	-.7076432E-08, .7933792E+08
UNSLAVE	1000460	.5660300	1.012151	-.99430123, 1.0001773

ANALYTIC/COMPARATIVE MATHEMATICS OF THE UNBOUNDED CASE OF THE SINGULAR CASE.

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16.11

ANALYSIS OF THE RECORDS OF THE NATIONAL ARCHIVES

OF THE NATIONAL ARCHIVES

OF THE NATIONAL ARCHIVES

OF THE NATIONAL ARCHIVES

[illegible]

DEPT	AMOUNT	DATE	DESCRIPTION	AMOUNT
100	100.00	10/1/70	100.00	100.00
200	200.00	10/1/70	200.00	200.00
300	300.00	10/1/70	300.00	300.00
400	400.00	10/1/70	400.00	400.00
500	500.00	10/1/70	500.00	500.00
600	600.00	10/1/70	600.00	600.00
700	700.00	10/1/70	700.00	700.00
800	800.00	10/1/70	800.00	800.00
900	900.00	10/1/70	900.00	900.00
1000	1000.00	10/1/70	1000.00	1000.00
1100	1100.00	10/1/70	1100.00	1100.00
1200	1200.00	10/1/70	1200.00	1200.00
1300	1300.00	10/1/70	1300.00	1300.00
1400	1400.00	10/1/70	1400.00	1400.00
1500	1500.00	10/1/70	1500.00	1500.00
1600	1600.00	10/1/70	1600.00	1600.00
1700	1700.00	10/1/70	1700.00	1700.00
1800	1800.00	10/1/70	1800.00	1800.00
1900	1900.00	10/1/70	1900.00	1900.00
2000	2000.00	10/1/70	2000.00	2000.00
2100	2100.00	10/1/70	2100.00	2100.00
2200	2200.00	10/1/70	2200.00	2200.00
2300	2300.00	10/1/70	2300.00	2300.00
2400	2400.00	10/1/70	2400.00	2400.00
2500	2500.00	10/1/70	2500.00	2500.00
2600	2600.00	10/1/70	2600.00	2600.00
2700	2700.00	10/1/70	2700.00	2700.00
2800	2800.00	10/1/70	2800.00	2800.00
2900	2900.00	10/1/70	2900.00	2900.00
3000	3000.00	10/1/70	3000.00	3000.00
3100	3100.00	10/1/70	3100.00	3100.00
3200	3200.00	10/1/70	3200.00	3200.00
3300	3300.00	10/1/70	3300.00	3300.00
3400	3400.00	10/1/70	3400.00	3400.00
3500	3500.00	10/1/70	3500.00	3500.00
3600	3600.00	10/1/70	3600.00	3600.00
3700	3700.00	10/1/70	3700.00	3700.00
3800	3800.00	10/1/70	3800.00	3800.00
3900	3900.00	10/1/70	3900.00	3900.00
4000	4000.00	10/1/70	4000.00	4000.00
4100	4100.00	10/1/70	4100.00	4100.00
4200	4200.00	10/1/70	4200.00	4200.00
4300	4300.00	10/1/70	4300.00	4300.00
4400	4400.00	10/1/70	4400.00	4400.00
4500	4500.00	10/1/70	4500.00	4500.00
4600	4600.00	10/1/70	4600.00	4600.00
4700	4700.00	10/1/70	4700.00	4700.00
4800	4800.00	10/1/70	4800.00	4800.00
4900	4900.00	10/1/70	4900.00	4900.00
5000	5000.00	10/1/70	5000.00	5000.00
5100	5100.00	10/1/70	5100.00	5100.00
5200	5200.00	10/1/70	5200.00	5200.00
5300	5300.00	10/1/70	5300.00	5300.00
5400	5400.00	10/1/70	5400.00	5400.00
5500	5500.00	10/1/70	5500.00	5500.00
5600	5600.00	10/1/70	5600.00	5600.00
5700	5700.00	10/1/70	5700.00	5700.00
5800	5800.00	10/1/70	5800.00	5800.00
5900	5900.00	10/1/70	5900.00	5900.00

DATE	DESCRIPTION	AMOUNT	BALANCE
1907	PAID TO	100.00	100.00
1908	PAID TO	200.00	300.00
1909	PAID TO	300.00	600.00
1910	PAID TO	400.00	1000.00
1911	PAID TO	500.00	1500.00
1912	PAID TO	600.00	2100.00
1913	PAID TO	700.00	2800.00
1914	PAID TO	800.00	3600.00
1915	PAID TO	900.00	4500.00
1916	PAID TO	1000.00	5500.00
1917	PAID TO	1100.00	6600.00
1918	PAID TO	1200.00	7800.00
1919	PAID TO	1300.00	9100.00
1920	PAID TO	1400.00	10500.00
1921	PAID TO	1500.00	12000.00
1922	PAID TO	1600.00	13600.00
1923	PAID TO	1700.00	15300.00
1924	PAID TO	1800.00	17100.00
1925	PAID TO	1900.00	19000.00
1926	PAID TO	2000.00	21000.00
1927	PAID TO	2100.00	23100.00
1928	PAID TO	2200.00	25300.00
1929	PAID TO	2300.00	27600.00
1930	PAID TO	2400.00	30000.00
1931	PAID TO	2500.00	32500.00
1932	PAID TO	2600.00	35100.00
1933	PAID TO	2700.00	37800.00
1934	PAID TO	2800.00	40600.00
1935	PAID TO	2900.00	43500.00
1936	PAID TO	3000.00	46500.00
1937	PAID TO	3100.00	49600.00
1938	PAID TO	3200.00	52800.00
1939	PAID TO	3300.00	56100.00
1940	PAID TO	3400.00	59500.00
1941	PAID TO	3500.00	63000.00
1942	PAID TO	3600.00	66600.00
1943	PAID TO	3700.00	70300.00
1944	PAID TO	3800.00	74100.00
1945	PAID TO	3900.00	78000.00
1946	PAID TO	4000.00	82000.00
1947	PAID TO	4100.00	86100.00
1948	PAID TO	4200.00	90300.00
1949	PAID TO	4300.00	94600.00
1950	PAID TO	4400.00	99000.00
1951	PAID TO	4500.00	103500.00
1952	PAID TO	4600.00	108100.00
1953	PAID TO	4700.00	112800.00
1954	PAID TO	4800.00	117600.00
1955	PAID TO	4900.00	122500.00
1956	PAID TO	5000.00	127500.00
1957	PAID TO	5100.00	132600.00
1958	PAID TO	5200.00	137800.00
1959	PAID TO	5300.00	143100.00
1960	PAID TO	5400.00	148500.00
1961	PAID TO	5500.00	154000.00
1962	PAID TO	5600.00	159600.00
1963	PAID TO	5700.00	165300.00
1964	PAID TO	5800.00	171100.00
1965	PAID TO	5900.00	177000.00
1966	PAID TO	6000.00	183000.00
1967	PAID TO	6100.00	189100.00
1968	PAID TO	6200.00	195300.00
1969	PAID TO	6300.00	201600.00
1970	PAID TO	6400.00	208000.00
1971	PAID TO	6500.00	214500.00
1972	PAID TO	6600.00	221100.00
1973	PAID TO	6700.00	227800.00
1974	PAID TO	6800.00	234600.00
1975	PAID TO	6900.00	241500.00
1976	PAID TO	7000.00	248500.00
1977	PAID TO	7100.00	255600.00
1978	PAID TO	7200.00	262800.00
1979	PAID TO	7300.00	270100.00
1980	PAID TO	7400.00	277500.00
1981	PAID TO	7500.00	285000.00
1982	PAID TO	7600.00	292600.00
198			

VARIABLES IN THE EQUATION						VARIABLES NOT IN THE EQUATION		
VARIABLE	B	SIG ESTIMATE	F	PARTIAL CORRELATION	TOLRANCE	F	SIGNIFICANCE	
Inter	.10326876E-01	.10326517E+01	1.1903554					
CONSTANT	1.1116124E	.1572380E	50.253669					
							.000	

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	R	SID ERROR	T	95% PCI CONFIDENCE INTERVAL
TIME	.117267657	.10826517E+01	1.0005712	-.0011264E+00, .1202472E+01
CONSTANT	1.1143794	.1572300	1.0004664	-.1007046, 1.6290705

VARIANCE/COVARIANCE MATRIX OF THE UNBIAIASED REGRESSION COEFFICIENTS.

1141 1142 1143

FILE NAME) (LOCATION DATE = 06 OCT 74) AT 0000Z 051100Z 04OCTU 0000Z 04OCTU

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INDEPENDENT VALUATION. POLYFAC INTERNATIONAL

1.1411 / 511. 11 V. 0.1145

[illegible]

DATE	DESCRIPTION	AMOUNT	BALANCE	CHECK NO.	DATE	DESCRIPTION	AMOUNT	BALANCE	CHECK NO.
1900	TO BALANCE	100.00	100.00						
1901	BY CHECK	50.00	50.00	1					
1902	TO CHECK	50.00	100.00	2					
1903	BY CHECK	50.00	50.00	3					
1904	TO CHECK	50.00	100.00	4					
1905	BY CHECK	50.00	50.00	5					
1906	TO CHECK	50.00	100.00	6					
1907	BY CHECK	50.00	50.00	7					
1908	TO CHECK	50.00	100.00	8					
1909	BY CHECK	50.00	50.00	9					
1910	TO CHECK	50.00	100.00	10					
1911	BY CHECK	50.00	50.00	11					
1912	TO CHECK	50.00	100.00	12					
1913	BY CHECK	50.00	50.00	13					
1914	TO CHECK	50.00	100.00	14					
1915	BY CHECK	50.00	50.00	15					
1916	TO CHECK	50.00	100.00	16					
1917	BY CHECK	50.00	50.00	17					
1918	TO CHECK	50.00	100.00	18					
1919	BY CHECK	50.00	50.00	19					
1920	TO CHECK	50.00	100.00	20					
1921	BY CHECK	50.00	50.00	21					
1922	TO CHECK	50.00	100.00	22					
1923	BY CHECK	50.00	50.00	23					
1924	TO CHECK	50.00	100.00	24					
1925	BY CHECK	50.00	50.00	25					
1926	TO CHECK	50.00	100.00	26					
1927	BY CHECK	50.00	50.00	27					
1928	TO CHECK	50.00	100.00	28					
1929	BY CHECK	50.00	50.00	29					
1930	TO CHECK	50.00	100.00	30					
1931	BY CHECK	50.00	50.00	31					
1932	TO CHECK	50.00	100.00	32					
1933	BY CHECK	50.00	50.00	33					
1934	TO CHECK	50.00	100.00	34					
1935	BY CHECK	50.00	50.00	35					
1936	TO CHECK	50.00	100.00	36					
1937	BY CHECK	50.00	50.00	37					
1938	TO CHECK	50.00	100.00	38					
1939	BY CHECK	50.00	50.00	39					
1940	TO CHECK	50.00	100.00	40					
1941	BY CHECK	50.00	50.00	41					
1942	TO CHECK	50.00	100.00	42					
1943	BY CHECK	50.00	50.00	43					
1944	TO CHECK	50.00	100.00	44					
1945	BY CHECK	50.00	50.00	45					
1946	TO CHECK	50.00	100.00	46					
1947	BY CHECK	50.00	50.00	47					
1948	TO CHECK	50.00	100.00	48					
1949	BY CHECK	50.00	50.00	49					

VARIABLES IN THE EQUATION		VARIABLES NOT IN THE EQUATION	
VARIABLE	STANDARD IS	VARIABLE	PARTIAL TOLERANCE F
	STANDARD		
	ELASTICITY		

ALL VARIABLES ARE IN THE EQUATION.

CONFIDENCE INTERVALS

Wavelength	λ	$\Delta\lambda$ (FWHM)	$\lambda/\Delta\lambda$	95.0 pct confidence interval
TIME	1.66777E-01	1.37594E-02	2.0000E+01	1.806E-01
Observed	1.6664E-01	5.7101E-01	1.6600E+01	1.1239E-01

VARIANCE/COVARIANCE MATRIX OF THE UNQUANTIZED OBSERVATION CORRELATIONS.

1000

Y100:

REGRESSION ANALYSIS - SUMMARY OF RESULTS

DEPENDENT VARIABLE: Y

INDEPENDENT VARIABLES: X1, X2, X3

MEAN OF DEPENDENT VARIABLE: 100.0000

STANDARD DEVIATION OF DEPENDENT VARIABLE: 10.0000

VARIABLES IN THE EQUATION: X1, X2, X3

ANALYSIS OF VARIANCE

SOURCE	SS	DF	MS	F	PROB > F
Regression	80.0000	3	26.6667	10.0000	.0001
Residual	20.0000	6	3.3333		
Total	100.0000	9			

COEFFICIENTS

VARIABLE	COEFFICIENT	STANDARD ERROR	T-VALUE	PROB > |T|
INTERCEPT	100.0000	10.0000	10.0000	.0001
X1	10.0000	1.0000	10.0000	.0001
X2	20.0000	1.0000	20.0000	.0001
X3	30.0000	1.0000	30.0000	.0001

VARIABLES NOT IN THE EQUATION

VARIABLE	COEFFICIENT	STANDARD ERROR	T-VALUE	PROB > |T|
X4	0.0000	1.0000	0.0000	.9999
X5	0.0000	1.0000	0.0000	.9999

OPERATIONAL CHARACTERISTICS

VARIABLES IN THE EQUATION: X1, X2, X3

ANALYSIS OF VARIANCE

SOURCE	SS	DF	MS	F	PROB > F
Regression	80.0000	3	26.6667	10.0000	.0001
Residual	20.0000	6	3.3333		
Total	100.0000	9			

COEFFICIENTS

VARIABLE	COEFFICIENT	STANDARD ERROR	T-VALUE	PROB > |T|
INTERCEPT	100.0000	10.0000	10.0000	.0001
X1	10.0000	1.0000	10.0000	.0001
X2	20.0000	1.0000	20.0000	.0001
X3	30.0000	1.0000	30.0000	.0001

VARIABLES NOT IN THE EQUATION

VARIABLE	COEFFICIENT	STANDARD ERROR	T-VALUE	PROB > |T|
X4	0.0000	1.0000	0.0000	.9999
X5	0.0000	1.0000	0.0000	.9999

FILE NAME LOCATION DATE = 04 JUL 78) MEASUREMENTS OF CONCENTRATIONS DATA

DEPENDENT VARIABLE = P1000 MEASUREMENT RESULTS

VARIABLES TO BE USED IN STEP WISE REGRESSION

MULTIPLIER	COEFFICIENT	ANALYSIS OF VARIANCE	OF	SUM OF SQUARES	MEAN SQUARE	F	SIGNIFICANCE
ADJUSTED R SQUARE	.74502	0.00000	1	.00001	.00001	0.00000	0.00000
STANDARD DEVIATION	.00110	0.00000	1	.00001	.00001	0.00000	0.00000

VARIABLES IN THE CONFIDENCE INTERVAL

VARIABLE	COEFFICIENT	STD ERROR	T	OF	PLAUSIBILITY	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFICANCE
INTERCEPT	1.00000000	.00000000	100.00000	1.00000	1.00000					
CONCENTRATION	0.00000000	.00000000	10.00000	1.00000	1.00000					
TEMPERATURE	0.00000000	.00000000	10.00000	1.00000	1.00000					
RELATIVE HUMIDITY	0.00000000	.00000000	10.00000	1.00000	1.00000					
CONSTANT	1.00000000	.00000000	100.00000	1.00000	1.00000					

ALL VARIABLES ARE IN THE CONFIDENCE INTERVAL

COEFFICIENTS AND CONFIDENCE INTERVALS

VARIABLE	COEFFICIENT	STD ERROR	T	OF	PLAUSIBILITY	95% CONFIDENCE INTERVAL
INTERCEPT	1.00000000	.00000000	100.00000	1.00000	1.00000	0.99751990-02
CONCENTRATION	0.00000000	.00000000	10.00000	1.00000	1.00000	0.99751990-02
TEMPERATURE	0.00000000	.00000000	10.00000	1.00000	1.00000	0.99751990-02
RELATIVE HUMIDITY	0.00000000	.00000000	10.00000	1.00000	1.00000	0.99751990-02
CONSTANT	1.00000000	.00000000	100.00000	1.00000	1.00000	0.99751990-02

VARIABLES/COEFFICIENTS MATRIX OF THE UNDETERMINED REGRESSION COEFFICIENTS

VARIABLE	COEFFICIENT	STD ERROR	T	OF	PLAUSIBILITY
INTERCEPT	1.00000000	.00000000	100.00000	1.00000	1.00000
CONCENTRATION	0.00000000	.00000000	10.00000	1.00000	1.00000
TEMPERATURE	0.00000000	.00000000	10.00000	1.00000	1.00000
RELATIVE HUMIDITY	0.00000000	.00000000	10.00000	1.00000	1.00000
CONSTANT	1.00000000	.00000000	100.00000	1.00000	1.00000

OUTSTANDING	Y VALU	Y FUTURE	WORTH	0.0
1.	1.000000	1.000135	--1351901-01	.
2.	1.000000	1.000135	--1351901-01	.
3.	1.000000	1.000135	--1351901-01	.
4.	1.000000	1.000135	--1351901-01	.
5.	1.000000	1.000135	--1351901-01	.
6.	1.000000	1.000135	--1351901-01	.
7.	1.000000	1.000135	--1351901-01	.
8.	1.000000	1.000135	--1351901-01	.
9.	1.000000	1.000135	--1351901-01	.
10.	1.000000	1.000135	--1351901-01	.
11.	1.000000	1.000135	--1351901-01	.
12.	1.000000	1.000135	--1351901-01	.
13.	1.000000	1.000135	--1351901-01	.
14.	1.000000	1.000135	--1351901-01	.
15.	1.000000	1.000135	--1351901-01	.
16.	1.000000	1.000135	--1351901-01	.
17.	1.000000	1.000135	--1351901-01	.
18.	1.000000	1.000135	--1351901-01	.
19.	1.000000	1.000135	--1351901-01	.
20.	1.000000	1.000135	--1351901-01	.
21.	1.000000	1.000135	--1351901-01	.
22.	1.000000	1.000135	--1351901-01	.
23.	1.000000	1.000135	--1351901-01	.
24.	1.000000	1.000135	--1351901-01	.
25.	1.000000	1.000135	--1351901-01	.
26.	1.000000	1.000135	--1351901-01	.
27.	1.000000	1.000135	--1351901-01	.
28.	1.000000	1.000135	--1351901-01	.
29.	1.000000	1.000135	--1351901-01	.
30.	1.000000	1.000135	--1351901-01	.
31.	1.000000	1.000135	--1351901-01	.
32.	1.000000	1.000135	--1351901-01	.
33.	1.000000	1.000135	--1351901-01	.
34.	1.000000	1.000135	--1351901-01	.
35.	1.000000	1.000135	--1351901-01	.
36.	1.000000	1.000135	--1351901-01	.
37.	1.000000	1.000135	--1351901-01	.
38.	1.000000	1.000135	--1351901-01	.
39.	1.000000	1.000135	--1351901-01	.
40.	1.000000	1.000135	--1351901-01	.
41.	1.000000	1.000135	--1351901-01	.
42.	1.000000	1.000135	--1351901-01	.
43.	1.000000	1.000135	--1351901-01	.
44.	1.000000	1.000135	--1351901-01	.
45.	1.000000	1.000135	--1351901-01	.
46.	1.000000	1.000135	--1351901-01	.
47.	1.000000	1.000135	--1351901-01	.
48.	1.000000	1.000135	--1351901-01	.
49.	1.000000	1.000135	--1351901-01	.
50.	1.000000	1.000135	--1351901-01	.
51.	1.000000	1.000135	--1351901-01	.
52.	1.000000	1.000135	--1351901-01	.

THE UNIVERSITY OF CHICAGO PRESS

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PERFORMANCE ENT, OF IN STEP NUMBER 1.0. INTERFAC. INTERFACE DETAILS

ITEM	COEFFICIENT OF VARIATION	STANDARD DEVIATION	MEAN SQUARE	STANDARD
1. COEFFICIENT OF VARIATION	0.0511	0.0511	0.0026	0.0511
2. STANDARD DEVIATION	0.0511	0.0511	0.0026	0.0511
3. MEAN SQUARE	0.0026	0.0026	0.0026	0.0026
4. STANDARD	0.0511	0.0511	0.0026	0.0511

----- VARIABLES IN THE FORMATION -----

[illegible]

VANJAILE (5) FVLS(5) UN 5(LP NIMBLEK 30. DEKUS
 UT 5(LIN MTU1818,PTC STAN1141)S

Year	ANALYSIS OF VARIANCE on Solution	SUM OF SQUARES	MEAN SQUARE
1960	1.0000	1.0000	1.0000
1961	1.0000	1.0000	1.0000
1962	1.0000	1.0000	1.0000
1963	1.0000	1.0000	1.0000
1964	1.0000	1.0000	1.0000
1965	1.0000	1.0000	1.0000
1966	1.0000	1.0000	1.0000
1967	1.0000	1.0000	1.0000
1968	1.0000	1.0000	1.0000
1969	1.0000	1.0000	1.0000
1970	1.0000	1.0000	1.0000
1971	1.0000	1.0000	1.0000
1972	1.0000	1.0000	1.0000
1973	1.0000	1.0000	1.0000
1974	1.0000	1.0000	1.0000
1975	1.0000	1.0000	1.0000
1976	1.0000	1.0000	1.0000
1977	1.0000	1.0000	1.0000
1978	1.0000	1.0000	1.0000
1979	1.0000	1.0000	1.0000
1980	1.0000	1.0000	1.0000
1981	1.0000	1.0000	1.0000
1982	1.0000	1.0000	1.0000
1983	1.0000	1.0000	1.0000
1984	1.0000	1.0000	1.0000
1985	1.0000	1.0000	1.0000
1986	1.0000	1.0000	1.0000
1987	1.0000	1.0000	1.0000
1988	1.0000	1.0000	1.0000
1989	1.0000	1.0000	1.0000
1990	1.0000	1.0000	1.0000
1991	1.0000	1.0000	1.0000
1992	1.0000	1.0000	1.0000
1993	1.0000	1.0000	1.0000
1994	1.0000	1.0000	1.0000
1995	1.0000	1.0000	1.0000
1996	1.0000	1.0000	1.0000
1997	1.0000	1.0000	1.0000
1998	1.0000	1.0000	1.0000
1999	1.0000	1.0000	1.0000
2000	1.0000	1.0000	1.0000
2001	1.0000	1.0000	1.0000
2002	1.0000	1.0000	1.0000
2003	1.0000	1.0000	1.0000
2004	1.0000	1.0000	1.0000
2005	1.0000	1.0000	1.0000
2006	1.0000	1.0000	1.0000
2007	1.0000	1.0000	1.0000
2008	1.0000	1.0000	1.0000
2009	1.0000	1.0000	1.0000
2010	1.0000	1.0000	1.0000
2011	1.0000	1.0000	1.0000
2012	1.0000	1.0000	1.0000
2013	1.0000	1.0000	1.0000
2014	1.0000	1.0000	1.0000
2015	1.0000	1.0000	1.0000
2016	1.0000	1.0000	1.0000
2017	1.0000	1.0000	1.0000
2018	1.0000	1.0000	1.0000
2019	1.0000	1.0000	1.0000
2020	1.0000	1.0000	1.0000
2021	1.0000	1.0000	1.0000
2022	1.0000	1.0000	1.0000
2023	1.0000	1.0000	1.0000
2024	1.0000	1.0000	1.0000
2025	1.0000	1.0000	1.0000
2026	1.0000	1.0000	1.0000
2027	1.0000	1.0000	1.0000
2028	1.0000	1.0000	1.0000
2029	1.0000	1.0000	1.0000
2030	1.0000	1.0000	1.0000
2031	1.0000	1.0000	1.0000
2032	1.0000	1.0000	1.0000
2033	1.0000	1.0000	1.0000
2034	1.0000	1.0000	1.0000
2035	1.0000	1.0000	1.0000
2036	1.0000	1.0000	1.0000
2037	1.0000	1.0000	1.0000
2038	1.0000	1.0000	1.0000
2039	1.0000	1.0000	1.0000
2040	1.0000	1.0000	1.0000
2041	1.0000	1.0000	1.0000
2042	1.0000	1.0000	1.0000
2043	1.0000	1.0000	1.0000
2044	1.0000	1.0000	1.0000
2045	1.0000	1.0000	1.0000
2046	1.0000	1.0000	1.0000
2047	1.0000	1.0000	1.0000
2048	1.0000	1.0000	1.0000
2049	1.0000	1.0000	1.0000
2050	1.0000	1.0000	1.0000
2051	1.0000	1.0000	1.0000
2052	1.0000	1.0000	1.0000
2053	1.0000	1.0000	1.0000
2054	1.0000	1.0000	1.0000
2055	1.0000	1.0000	1.0000
2056	1.0000	1.0000	1.0000
2057	1.0000	1.0000	1.0000
2058	1.0000	1.0000	1.0000
2059	1.0000	1.0000	1.0000
2060	1.0000	1.0000	1.0000
2061	1.0000	1.0000	1.0000
2062	1.0000	1.0000	1.0000
2063	1.0000	1.0000	1.0000
2064	1.0000	1.0000	1.0000
2065	1.0000	1.0000	1.0000
2066	1.0000	1.0000	1.0000
2067	1.0000	1.0000	1.0000
2068	1.0000	1.0000	1.0000
2069	1.0000	1.0000	1.0000
2070	1.0000	1.0000	1.0000
2071	1.0000	1.0000	1.0000
2072	1.0000	1.0000	1.0000
2073	1.0000	1.0000	1.0000
2074	1.0000	1.0000	1.0000
2075	1.0000	1.0000	1.0000
2076	1.0000	1.0000	1.0000
2077	1.0000	1.0000	1.0000
2078	1.0000	1.0000	1.0000
2079	1.0000	1.0000	1.0000
2080	1.0000	1.0000	1.0000
2081	1.0000	1.0000	1.0000
2082	1.0000	1.0000	1.0000
2083	1.0000	1.0000	1.0000
2084	1.0000	1.0000	1.0000
2085	1.0000	1.0000	1.0000
2086	1.0000	1.0000	1.0000
2087	1.0000	1.0000	1.0000
2088	1.0000	1.0000	1.0000
2089	1.0000	1.0000	1.0000
2090	1.0000	1.0000	1.0000
2091	1.0000	1.0000	1.0000
2092	1.0000	1.0000	1.0000
2093	1.0000	1.0000	1.0000
2094	1.0000	1.0000	1.0000
2095	1.0000	1.0000	1.0000
2096	1.0000	1.0000	1.0000
2097	1.0000	1.0000	1.0000
2098	1.0000	1.0000	1.0000
2099	1.0000	1.0000	1.0000
2100	1.0000	1.0000	1.0000
2101	1.0000	1.0000	1.0000
2102	1.0000	1.0000	1.0000
2103	1.0000	1.0000	1.0000
2104	1.0000	1.0000	1.0000
2105	1.0000	1.0000	1.0000
2106	1.0000	1.0000	1.0000
2107	1.0000	1.0000	1.0000
2108	1.0000	1.0000	1.0000
2109	1.0000	1.0000	1.0000
2110	1.0000	1.0000	1.0000
2111	1.0000	1.0000	1.0000
2112	1.0000	1.0000	1.0000
2113	1.0000	1.0000	1.0000
2114	1.0000	1.0000	1.0000
2115	1.0000	1.0000	1.0000
2116	1.0000	1.0000	1.0000
2117	1.0000	1.0000	1.0000
2118	1.0000	1.0000	1.0000
2119	1.0000	1.0000	1.0000
2120	1.0000	1.0000	1.0000
2121	1.0000	1.0000	1.0000
2122	1.0000	1.0000	1.0000
2123	1.0000	1.0000	1.0000
2124	1.0000	1.0000	1.0000
2125	1.0000	1.0000	1.0000
2126	1.0000	1.0000	1.0000
2127	1.0000	1.0000	1.0000
2128	1.0000	1.0000	1.0000
2129	1.0000	1.0000	1.0000
2130	1.0000	1.0000	1.0000
2131	1.0000	1.0000	1.0000
2132	1.0000	1.0000	1.0000
2133	1.0000	1.0000	1.0000
2134	1.0000	1.0000	1.0000
2135	1.0000	1.0000	1.0000
2136	1.0000	1.0000	1.0000
2137	1.0000	1.0000	1.0000
2138	1.0000	1.0000	1.0000
2139	1.0000	1.0000	1.0000
2140	1.0000	1.0000	1.0000
2141	1.0000	1.0000	1.0000
2142	1.0000	1.0000	1.0000
2143	1.0000	1.0000	1.0000
2144	1.0000	1.0000	1.0000
2145	1.0000	1.0000	1.0000
2146	1.0000	1.0000	1.0000
2147	1.0000	1.0000	1.0000
2148	1.0000	1.0000	1.0000
2149	1.0000	1.0000	1.0000
2150	1.0000	1.0000	1.0000
2151	1.0000	1.0000	1.0000
2152	1.0000	1.0000	1.0000
2153	1.0000	1.0000	1.0000
2154	1.0000	1.0000	1.0000
2155	1.0000	1.0000	1.0000
2156	1.0000	1.0000	1.0000
2157	1.0000	1.0000	1.0000
2158	1.0000	1.0000	1.0000
2159	1.0000	1.0000	1.0000
2160	1.0000	1.0000	1.0000
2161	1.0000	1.0000	1.0000
2162	1.0000	1.0000	1.0000
2163	1.0000	1.0000	1.0000
2164	1.0000	1.0000	1.0000
2165	1.0000	1.0000	1.0000
2166	1.0000	1.0000	1.0000
2167	1.0000	1.0000	1.0000
2168	1.0000	1.0000	1.0000
2169	1.0000	1.0000	1.0000
2170	1.0000	1.0000	1.0000
2171	1.0000	1.0000	1.0000
2172	1.0000	1.0000	1.0000
2173	1.0000	1.0000	1.0000
2174	1.0000	1.0000	1.0000
2175	1.0000	1.0000	1.0000
2176	1.0000	1.0000	1.0000
2177	1.0000	1.0000	1.0000
2178	1.0000	1.0000	1.0000
2179	1.0000	1.0000	1.0000
2180	1.0000	1.0000	1.0000
2181	1.0000	1.0000	1.0000
2182	1.0000	1.0000	1.0000
2183	1.0000	1.0000	1.0000
2184	1.0000	1.0000	1.0000
2185	1.0000	1.0000	1.0000
2186	1.0000	1.0000	1.0000
2187	1.0000	1.0000	1.0000
2188	1.0000	1.0000	1.0000
2189	1.0000	1.0000	1.0000
2190	1.0000	1.0000	1.0000
2191	1.0000	1.0000	1.0000
2192	1.0000	1.0000	1.0000
2193	1.0000	1.0000	1.0000
2194	1.0000	1.0000	1.0000
2195	1.0000	1.0000	1.0000
2196	1.0000	1.0000	1.0000
2197	1.0000	1.0000	1.0000
2198	1.0000	1.0000	1.0000
2199	1.0000	1.0000	1.0000
2200	1.0000	1.0000	1.0000
2201	1.0000	1.0000	1.0000
2202	1.0000	1.0000	1.0000
2203	1.0000	1.0000	1.0000
2204	1.0000	1.0000	1.0000
2205	1.0000	1.0000	1.0000
2206	1.0000	1.0000	1.0000
2207	1.0000	1.0000	1.0000
2208	1.0000	1.0000	1.0000
2209	1.0000	1.0000	1.0000
2210	1.0000	1.0000	1.0000
2211	1.0000	1.0000	1.0000
2212	1.0000	1.0000	1.0000
2213	1.0000	1.0000	1.0000
2214	1.0000	1.0000	1.0000
2215	1.0000	1.0000	1.0000
2216	1.0000	1.0000	1.0000
2217	1.0000	1.0000	1.0000
2218	1.0000	1.0000	1.0000
2219	1.0000	1.0000	1.0000
2220	1.0000	1.0000	1.0000
2221	1.0000	1.0000	1.0000
2222	1.0000	1.0000	1.0000
2223	1.0000	1.0000	1.0000
2224	1.0000	1.0000	1.0000
2225	1.0000	1.0000	1.0000
2226	1.0000	1.0000	1.0000
2227	1.0000	1.0000	1.0000
2228			

----- VARIABLES IN THE EQUATION -----

VARIABLE	β	STANDARD	t	STANDARD	CRITICAL	TOLERANCE	ADJUSTED
		ERROR		ERROR			R-SQUARE
INTERAC	0.01160000	0.04311900	-0.1	0	0.000000	0.000000	0.000000
DEGREE5	0.00165000	0.13185970	-0.1	0.000000	0.000000	0.000000	0.000000

[illegible]

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[illegible]

-----VARIABLES IN THE EQUATION

VARIABLE	B	STD ERROR B	B STANDARD ERROR	T	DF	P	VAR	PARTIAL CORRELATION	TOLERANCE	F SIGNIFICANCE
INTREAC	.27620194	.11032947E-01	.39475179	.7737612	1	.59076				
DEWSS	.11671149	.17700825E-01	.41937627	.4020519	1	.6926				
MISREQ	-.17515107	.39777297E-01	.18732571	-.2157555	1	.6926				
(CONSTANT)	17.645168	.39720507E-01	17.645168							

ALL VARIABLES ARE IN THE FUZZY STATE.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	Q	STD. ERROR	T	35.00 OUT COMING-ICE INTERVAL
LOG MEAC	2.7626394	.7103294	-0.1	16.56767
CHES	.11571194	.1770002	-0.1	0.5885131
MINST	-17.512187	3.977261	-4.5	227.1133
CONSTANT	17.564104	9.512650	0	45.195100

VAR1A11/COVAR11 AND THE DEPENDENT VARIABLE

[illegible]

Observation	Y VALUE	Y ESTIMATE	WIND SPEED	WIND DIRECTION	WIND VELOCITY
1.	1.00000	1.01100	10	100	10.0
2.	1.00000	1.01100	10	100	10.0
3.	1.00000	1.01100	10	100	10.0
4.	1.00000	1.01100	10	100	10.0
5.	1.00000	1.01100	10	100	10.0
6.	1.00000	1.01100	10	100	10.0
7.	1.00000	1.01100	10	100	10.0
8.	1.00000	1.01100	10	100	10.0
9.	1.00000	1.01100	10	100	10.0
10.	1.00000	1.01100	10	100	10.0
11.	1.00000	1.01100	10	100	10.0
12.	1.00000	1.01100	10	100	10.0
13.	1.00000	1.01100	10	100	10.0
14.	1.00000	1.01100	10	100	10.0
15.	1.00000	1.01100	10	100	10.0
16.	1.00000	1.01100	10	100	10.0
17.	1.00000	1.01100	10	100	10.0
18.	1.00000	1.01100	10	100	10.0
19.	1.00000	1.01100	10	100	10.0
20.	1.00000	1.01100	10	100	10.0
21.	1.00000	1.01100	10	100	10.0
22.	1.00000	1.01100	10	100	10.0
23.	1.00000	1.01100	10	100	10.0
24.	1.00000	1.01100	10	100	10.0
25.	1.00000	1.01100	10	100	10.0
26.	1.00000	1.01100	10	100	10.0
27.	1.00000	1.01100	10	100	10.0
28.	1.00000	1.01100	10	100	10.0
29.	1.00000	1.01100	10	100	10.0
30.	1.00000	1.01100	10	100	10.0
31.	1.00000	1.01100	10	100	10.0
32.	1.00000	1.01100	10	100	10.0
33.	1.00000	1.01100	10	100	10.0
34.	1.00000	1.01100	10	100	10.0
35.	1.00000	1.01100	10	100	10.0
36.	1.00000	1.01100	10	100	10.0
37.	1.00000	1.01100	10	100	10.0
38.	1.00000	1.01100	10	100	10.0
39.	1.00000	1.01100	10	100	10.0
40.	1.00000	1.01100	10	100	10.0
41.	1.00000	1.01100	10	100	10.0
42.	1.00000	1.01100	10	100	10.0
43.	1.00000	1.01100	10	100	10.0
44.	1.00000	1.01100	10	100	10.0
45.	1.00000	1.01100	10	100	10.0
46.	1.00000	1.01100	10	100	10.0
47.	1.00000	1.01100	10	100	10.0
48.	1.00000	1.01100	10	100	10.0
49.	1.00000	1.01100	10	100	10.0
50.	1.00000	1.01100	10	100	10.0

R

MULTIPLE REGRESSION OF MEAN ADJUSTED RESIDUALS

14 OCT 76 PAGE 20

FILE WORD REGRESSION DATE = 04 OCT 76 MEAN ADJUSTED RESIDUALS DATA

OBSERVATION	Y VALUE	Z ESTIMATE	RESIDUAL	0.0
51.	1.450000	1.401136	.048864E+01	1
52.	1.120000	1.271075	-.151075E+01	1
53.	1.100000	1.177454	-.077454E+01	1
56.	1.130000	1.063297	-.063297E+01	1
57.	1.100000	1.216771	-.116771E+01	1
58.	1.100000	1.176454	-.076454E+01	1
59.	1.100000	1.216771	-.116771E+01	1
60.	1.100000	1.202620	-.102620E+01	1

NOTE - (*) INDICATES ESTIMATE CALCULATED WITH MEAN SUBSTITUTION

q INDICATES POINT OUT OF RANGE OF PLUT

NUMBER OF CASES INCLUDED 60
NUMBER OF Z-Score CALCULATIONS 2.00 3.33 PERCENT OF THE TOTAL

VARIANCE RATIO 1.70173 IMPROVEMENT TEST 1.75203

NUMBER OF POSITIVE RESIDUALS 10

NUMBER OF NEGATIVE RESIDUALS 42

NUMBER OF Z-Score CALCULATIONS 28

EXPECTED NUMBER OF SIGNS 28

EXPECTED SIGN OF THE DISTRIBUTION 1.21501

TEST STATISTIC 1.21501

TEST STATISTIC (NORMALIZED) 1.21501

PROBABILITY OF OBTAINING A GREATER ABSOLUTE 1.21501

DEPENDENT VARIABLE IS: MEAN RESPONSE
 MEAN RESPONSE 1.76100 STD. DEV. .01895
 VARIABLE(S) ENTERED ON STEP NUMBER 1: WISHER DISPOSITION

MULTIPLE R .79076 ANALYSIS OF VARIANCE OF SUM OF SQUARES MEAN SQUARE F SIGNIFICANT
 R SQUARE .6318 REGRESSION 14.15270 14.15270 100.0000
 ADJUSTED R SQUARE .60605 RESIDUAL 9.13016 .18010
 STD DEVIATION .42890 COEFF OF VARIABILITY 24.6107

VARIABLES IN THE EQUATION

VARIABLE	B	STD ERROR	T	DF	COEFF	ELASTICITY	PARTIAL	TOLERANCE	F	SIGNIFICANT
WISHER	.22146211	.72177524	100.96853	1	.79076		.76039	.80365	78.135257	
CONSTANT	-.24149053	.22146211	-99.821294	1	176.07676		.00000	.80867	17.037337	

VARIABLE(S) ENTERED ON STEP NUMBER 2: WISHER OPERATIONAL CHARACTERISTICS

MULTIPLE R .81609 ANALYSIS OF VARIANCE OF SUM OF SQUARES MEAN SQUARE F SIGNIFICANT
 R SQUARE .66610 REGRESSION 19.05136 19.05136 156.64706
 ADJUSTED R SQUARE .82070 RESIDUAL 3.42916 .006016
 STD DEVIATION .24520 COEFF OF VARIABILITY 19.2407

VARIABLES IN THE EQUATION

VARIABLE	B	STD ERROR	T	DF	COEFF	ELASTICITY	PARTIAL	TOLERANCE	F	SIGNIFICANT
WISHER	1.0445445	16.270707	96.67250	1	.800272		.00000	.00341	12.009413	
OPERCHAR	1.1057472	.02011567	73.43067	1	106.2464		.00000	.00341	12.009413	

$$\text{b) } \mathbb{E}[\mathbf{f}(\mathbf{X})] = \mathbf{f}(\mathbf{X}) \quad \text{and} \quad \mathbb{E}[\mathbf{f}(\mathbf{X})] = \mathbf{f}(\mathbf{X}) \quad \text{if} \quad \mathbf{f}(\mathbf{X}) = \mathbf{f}(\mathbf{X})$$

1. 16217
 1. 16217
 1. 16217

1. The first step is to identify the problem. This involves understanding the current situation and what needs to be changed.

[illegible][illegible][illegible][illegible]

TABLE NO.	DATE	TO	BY	FOR	REMARKS
1	1900	...	...	...	...
2	1900	...	...	...	...
3	1900	...	...	...	...
4	1900	...	...	...	...
5	1900	...	...	...	...
6	1900	...	...	...	...
7	1900	...	...	...	...
8	1900	...	...	...	...
9	1900	...	...	...	...
10	1900	...	...	...	...

DEPENDENT VARIABLE: TOLLNOC INTERSTATE DEPT.

VARIABLE(S) ENTERED ON STEP: 1. MIS40 ALSTOOR APPROPRIATE

MULTIPLE R .90557
R SQUARE .82007
ADJUSTED R SQUARE .81609
STD DEVIATION .06435

MEAN SQUARE
1.01609
.00199

F 254.57736
SIGNIFICANT
0

----- VARIABLES IN THE EQUATION -----

VARIABLE	B	STD ERROR B	F	DF	ELASTICITY	VARIABLE	PARTIAL	TOLERANCE	F	SIGNIFICANT
----------	---	-------------	---	----	------------	----------	---------	-----------	---	-------------

OPCHAD 1.0029329 .0040842FE-01 394.75179 1.1117906

DEMS -.012699700 .3604766E-01 12.62341 1.0000000

YISREB .21.064799 6.2450762 9.4641276 1.1117906

(CONSTANT) -.21.627719 6.2450762 9.4641276 1.1117906

ALL VARIABLES ARE IN THE EQUATION.

COEFFICIENTS AND CONFIDENCE INTERVALS.

VARIABLE	B	STD ERROR B	T	DF	PUT COEFFICIENT INTERVAL
OPCHAD	1.0029329	.0040842FE-01	10.56774	1.1117906	1.6084000
DEMS	-.012699700	.3604766E-01	-3.5237000	1.1117906	-.0000000
YISREB	.21.064799	6.2450762	3.3764772	1.1117906	19.763492
CONSTANT	-.21.627719	6.2450762	-3.4606000	1.1117906	-1.6084000

VARIABLE/COEFFICIENT VALUES ON THE DEPENDENT VARIABLE.

VARIABLE	B	STD ERROR B	T	DF	PUT COEFFICIENT INTERVAL
OPCHAD	1.0029329	.0040842FE-01	10.56774	1.1117906	1.6084000
DEMS	-.012699700	.3604766E-01	-3.5237000	1.1117906	-.0000000
YISREB	.21.064799	6.2450762	3.3764772	1.1117906	19.763492
CONSTANT	-.21.627719	6.2450762	-3.4606000	1.1117906	-1.6084000

[illegible]

where $\mathbf{f}(\mathbf{t}) = \mathbf{f}(\mathbf{t}|\mathbf{y}^{\text{obs}})$ is the conditional density of \mathbf{t} given \mathbf{y}^{obs} and $\mathbf{f}(\mathbf{t}) = \mathbf{f}(\mathbf{t}|\mathbf{y}^{\text{obs}}, \mathbf{y}^{\text{unobs}})$ is the joint density of \mathbf{t} and $\mathbf{y}^{\text{unobs}}$ given \mathbf{y}^{obs} .

Figure 1. The effect of the concentration of the *Ag* on the *Ag* adsorption capacity of the *Ag*-*Ag*2S₂O₈ system.

$$\{ \psi_{\alpha} \} = \{ \psi_{\alpha}(0), \psi_{\alpha}(1), \dots, \psi_{\alpha}(N) \}$$
[illegible]

17. 1,216,000 1,216,000

1,271,665,760,000

Table 1

NOTE - (a) INDICATES ESTIMATE CALCULATED AT 100% SUBSTITUTION
 (b) INDICATES POINT USE OF RANGE OF PLUG

	69.
Amounts of cash on hand	\$ 69.00
Amounts of cash on hand	\$ 69.00
Total	\$ 138.00

[illegible]

REFERENCES

Number of hours of work of 1000 men in 1914

EXPOSITION ABSTRACTS OF STUDENTS

DATE OF VISIT - 05/06/2007

PROBABILITY OF "OBTAINING" OF. AQS (7) .6955

BIBLIOGRAPHY

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1. Babiarz, Anthony S., and Peter W. Giedras. "A Model to Predict Final Cost Growth in a Weapon System Development Program," Wright-Patterson Air Force Base, Ohio: Air Force Institute of Technology, August 1975. Master's Thesis.
2. Barker, Harold Douglas, and Charles Benson Creighton. "Service/OSD Interface in the Initiation of Major Defense Systems Acquisition," Monterey, Ca: Naval Postgraduate School, March 1973. Master's Thesis.
3. Blalock, Hubert M. Jr., and Ann B. Blalock. Methodology in Social Research. New York, N.Y.: McGraw-Hill Book Company, 1968.
4. Bruner, Jerome S.; Jacqueline J. Goodnow; and George A. Austin. A Study of Thinking. New York, N.Y.: John Wiley and Sons, Inc., 1956.
5. Busek, Joseph R. "A Historical Analysis of Total Package Procurement Life Cycle Costing, and Design to Cost," Wright-Patterson Air Force Base: Air Force Institute of Technology, June 1976. Master's Thesis.
6. Cleland, David I., and William R. King. Systems Analysis and Project Management. New York, N.Y.: McGraw-Hill Book Company, 1968.
7. Croxton, Frederick E.; Dudley J. Cowden; and Sidney Klein. Applied General Statistics. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1967.
8. DeGroot, Morris H. Probability and Statistics. Reading, Mass.: Addison-Wesley Publishing Company, 1975.
9. Diesing, Paul. Patterns of Discovery in the Social Sciences. Chicago, Ill.: Aldine-Atherton, Inc., 1971.
10. Dietrich, Fred. "System Acquisition - How A-109 Can Help Shorten the Process," Government Executive Vol. 9, pp. 10-11, October 1977.

11. Ellis, Willis D. A Source Book of Gestalt Psychology. London, England: Kegan Paul, Trench, Trubner and Company, Ltd., 1938.
12. Ferratt, Thomas W., and Frederick A. Starke. "Avoiding Systems Mismanagement," Journal of Systems Management, Vol. 29, pp. 6-8, July 1978.
13. Fleiss, Joseph L. Statistical Methods for Rates and Proportions. New York, N.Y.: John Wiley and Sons, 1973.
14. Glover, William L., and John O. Lenz. "A Cost Growth Model for Weapon System Development Programs," Wright-Patterson Air Force Base, Ohio: Air Force Institute of Technology, August 1974. Master's Thesis.
15. Grayson, Anthony S., and Harold J. Lanclos. "A Methodology for Subjective Assessment of Probability Distributions," Wright-Patterson Air Force Base, Ohio: Air Force Institute of Technology, September 1976. Master's Thesis.
16. Henry, Douglas Davies, "A Statistical Analysis of the Effectiveness of Program Initial Conditions as Predictors of Weapon System Acquisition Program Success," Monterey, Ca: Naval Postgraduate School, December 1976. Master's Thesis.
17. Hilten, John W., "Who Says You Have a Major Development Program," Fort Belvoir, Va: Defense Systems Management College, November 1976.
18. Holzapple, J. R., Lieutenant General. "Air Force System Command Report 375-1 Number 52, "Washington, D.C.: Deputy Chief of Staff for Research and Development, 1972.
19. Hoskins, Charles J. "Analysis of Engineering Transfer of Acquisition Systems," Fort Belvoir, Va: Defense Systems Management College, May 1976.
20. Jeas, William C. "Development of Weapon Systems: a Process of Technical Uncertainty Identification and Resolution," Fort Belvoir, Va: Defense Systems Management College, January 1976.

21. Johnston, J. Econometric Methods. New York, N.Y.: McGraw-Hill Book Company, 1972.
22. Kaffka, K. Principles of Gestalt Psychology. New York, N.Y.: Harcourt, Brace and Company, 1935.
23. Kozmetsky, G., and Cunningham, I. "The Importance of Management Epistemology and Reasons for Including it in the Integrative Course," Unpublished paper, Graduate School of Business, The University of Texas at Austin.
24. Katz, Daniel, and Robert L. Kahn. The Social Psychology of Organizations. New York, N.Y.: John Wiley and Sons, Inc., 1966.
25. Kaufman, Herbert. "Emerging Conflicts in the Doctrines of Public Administration," American Political Science Review Vol. 50, pp. 1057-1073, December 1956.
26. Kaufman, Louis Albert. "The Influence of Life Cycle on Organization Structure in Aerospace Programs," Los Angeles, Ca: University of Southern California, 1974. DBA Dissertation.
27. Ketchum, R. Leon-Girhard, and Burton E. McKenzie. "Lessons Learned in USAF Weapon System Acquisition and Management: a Case Study Approach," Wright-Patterson Air Force Base, Ohio: Air Force Institute of Technology, September 1976. Master's Thesis.
28. Lee, Robert G. "An Evaluation of the Data Proliferation Problem within Major Air Force Acquisition Programs," Wright-Patterson Air Force Base, Ohio: Air Force Institute of Technology, February 1972. Master's Thesis.
29. Lewis, Edwin M., and Eugene D. Pearson. "The Air Force Cost Estimating Process; the Agencies Involved and Estimating Techniques Used," Wright-Patterson Air Force Base, Ohio: Air Force Institute of Technology, June 1977. Master's Thesis.
30. March, J. G., and H. A. Simon. Organizations. New York, N.Y.: John Wiley and Sons, Inc., 1958.

31. Martin, Dean Martin. "A Conceptual Cost Model for Uncertainty Parameters Affecting Negotiated, Sole-Source Development Contracts," Norman, Okla.: The University of Oklahoma, 1971. PhD. Dissertation.
32. McCrea, Gerald D. "The Impact of Secretary Robert S. McNamara on the Department of Defense," Maxwell Air Force Base, Ala.: Air War College, April 1969.
33. Meehan, John D., and Thomas O. Millett. "Major Weapon System Acquisition - - an Analysis of DoD Management Arrangements," Wright-Patterson Air Force Base, Ohio: Air Force Institute of Technology, January 1969. Master's Thesis.
34. Meiners, Arthur C. "Control of Major Changes to and Resultant Cost Growth in Weapon Systems Acquisition Contracts," Fort Belvoir, Va.: Defense Systems Management College, February 1974. PhD. Dissertation.
35. Mosher, Frederick C., Democracy and the Public Service. New York, N.Y.: Oxford University Press 1968.
36. Neter, John, and William Wasserman. Applied Linear Statistical Models. Homewood, Ill.: Richard D. Irwin, Inc., 1974.
37. Nie, Norman H.; C. Hadlai Hull; Jean G. Jenkins; Karin Steinbrenner; and Dale H. Bent. Statistical Package for the Social Sciences, second Edition. New York, N.Y.: McGraw-Hill Book Company, 1975.
38. Nigro, Lloyd. "Administrative Behavior and Self-Rationalized Man," Political Science Journal Vol. 5, pp. 29-34, Autumn 1976.
39. Peck, Merton J., and Frederic M. Scherer. The Weapons Acquisition Process: an Economic Analysis. Boston, Mass.: Division of Research, Graduate School of Business, Harvard University, 1962.
40. Pedlikin, Howard L. "An Overview of the U. S. Air Force Budget System," Fort Belvoir, Va.: Defense Systems Management College, February 1974.

41. Perry, Robert. "A Prototype Strategy for Aircraft Development," Santa Monica, Ca: Rand Corporation. July 1972.
42. Pindyck, Robert S., and Daniel L. Rubinfeld. Econometric Models and Economic Forecasts. New York, N.Y.: McGraw-Hill Book Company, 1976.
43. Pray, David E., and Jack M. Wells. "A Comparative Analysis of the US Army and US Air Force Requirements Definition During the Conceptual Phase of the Material Acquisition Process," Fort Belvoir, Va.: Defense Systems Management College, November 1975. Master's Thesis.
44. Putnam, W. D. "The Evolution of Air Force System Acquisition Management," Santa Monica, Ca.: Rand Corporation, August 1972.
45. Roman, Daniel D. Research and Development Management: the Economics and Administration of Technology. New York, N.Y.: Appleton Century-Crofts, 1968.
46. Sherwin, C. W., and R. S. Isenson. "First Interim Report on Project Hindsight (Summary)," Washington, D. C.: Office of the Director of Defense Research and Engineering, June 1966.
47. Simon, Herbert A. Administrative Behavior. New York, N.Y.: The Macmillan Co., 1948.
48. Snedecor, George W., and William G. Cochran. Statistical Methods. Ames, Iowa: The Iowa State University Press, 1976.
49. Sponsler, George C.; Dominique Gignoux; and Norman N. Rubin. "Parametric Cost Estimation of Fighter Aircraft," Gaithersburg, Md.: Columbia Research Corporation, December 1973.
50. Staff-Assistant Secretary for Defense (Installations and Logistics). "The DoD-Contractor Relationship," Washington, D. C.: Logistics Management Institute, November 1973.

51. Staff-Office of Federal Procurement Policy. "Major Acquisitions - - a Discussion of the Application of OMB Circular No. A-109," Washington, D.C.: Office of Management and Budget, August 1976.
52. Strayer, Daniel E., and Lyle W. Lockwood. "What are We Buying Here?," Wright-Patterson Air Force Base, Ohio: Air Force Business Research Management Center, 1977.
53. Thompson, James D. Organizations in Action. New York, N.Y.: McGraw-Hill Book Company, 1967.
54. Timson, F. S., "Decision Making Under Aggregate Uncertainty: the Engineering Decisions in a System Development Project," Los Angeles, Ca: University of California at Los Angeles, June 1969. DBA Dissertation.
55. Unknown. "The Development of Requirements for Major Weapon Systems," Washington, D.C.: Logistics Management Institute, July 1973.
56. Witt, Hugh E., and James T. Lynn. "Circular No. A-109, Major Systems Acquisition," Washington, D.C.: Office of Management and Budget, April 1976.

VITA

Ronald Gene Blackledge was born on August 12, 1941 in Montgomery, Alabama. He graduated from college in 1964 with a degree in Aerospace Engineering from Texas A & M University where he also met and married Lillian Lois Howard. Upon graduation, he began a career as an Air Force officer. During the subsequent years, the Blackledge's had two sons, Kevin and Bryan. He has had Air Force tours in aircraft programs, a satellite project and a satellite tracking agency, and progressed during this time to the current rank of Major. Major Blackledge earned a Master's degree in management at the University of Southern California in 1969. He is a member of Beta Gamma Sigma and Phi Kappa Phi. After completion of the PhD program at The University of Texas at Austin, he will be a professor of management at the Graduate School of Logistics at Wright-Patterson Air Force Base in Dayton, Ohio.

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